

1991-1995

PHILIP MORRIS USA R&D

STRATEGIC PLAN

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Executive Summary

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The 1990 PM USA R&D Five Year Strategic Plan is based on an internal analysis, including current R&D programs and resources; an external analysis, including competitors, suppliers, and available technology; and an analysis of future factors which are anticipated to impact our business during the plan period.

From the analysis of future factors, strategic threats and opportunities are emerging in the following areas: the marketplace, social/political issues, technology, and our internal environment. The key marketplace factors relate to a declining market, dynamic market, increasing export market, product changes required due to government regulations, and technology-driven products. In a declining market, volume gain can be achieved by maximizing the potential of existing brands, attracting consumers with value-added products, and increasing representation in all strategic market segments underrepresented by PM (e.g. menthol, ultra low tar, price/value). New market segments (dynamic market) add to the proliferation of products but, on the other hand, provide additional market opportunities (e.g. price/value and older smokers). Taxes on cigarettes are increasing. This, along with industry pricing policies, means our consumers are paying more for a pack of cigarettes. Thus, it is important to increase value to the consumer by maximizing the quality of our full margin brands. Maintaining subjective quality, automated inspection systems, freshness improvements, maintaining consistency and improved packaging are potential ways to increase benefit to the consumer. Maximizing the potential of our full margin brands will have a more significant impact on our profitability. The increasing export market requires additional resources to support and continue growth as well as create new market segments. Product changes due to government regulations involves reducing ignition propensity; reducing, consolidating, and managing ingredients; modifying and labeling smoke content; and modifying the product to counteract smoking restrictions (low sidestream) or environmental tobacco smoke issues (Project PACT). Technology-driven products are being developed to address consumer wants and external requirements. Some product development is shorter-term in nature (i.e. reduced sidestream/paper technology); however, other products will require much longer timeframes (i.e. Project Beta).

Many social/political factors will affect the business during the plan period. Perceived health concerns, social acceptability, environmental issues, and a multitude of legislative activity at all levels of government will continue to affect our industry. Key legislative activities affecting R&D involve the regulation of ingredients, smoke content, and ignition propensity. A wide variety of R&D activities will be devoted to addressing these issues. Some of these include developing ignition propensity tests and modeling studies, managing and consolidating ingredients, product development and modifications to address smoke content restrictions and

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labeling requirements, and developing products which meet consumer wants and marketplace issues.

Technologies have proliferated and will continue to proliferate. The success of future product development and commercialization efforts is dependent on our ability to maximize the utilization of available technologies that are of strategic interest to our business. Mechanisms are discussed through which externally developing technologies are identified, evaluated, and strategic technologies selected for implementation into our programs and products.

Internal environment factors relate to the needs of our company which will affect our ability to do business in the future. R&D programs have been developed to address certain operations issues relating to capacity (e.g. Cast Leaf and New Expanded Tobacco Processes), manufacturing support (materials for high speed manufacturing cost efficiency), raw material supply, quality (flavor and adhesive specifications, and materials evaluation), and dependence on suppliers. Cost efficiencies should be maximized throughout the Company. New products, new technologies and the large number of issues facing the Company in the foreseeable future all may threaten to increase the cost of doing business. R&D programs are generally conducted in a manner that maintains PM's proprietary position. While this strategy may increase initial R&D investment, and therefore R&D cost, "ownership" of important product and process technology can certainly lower the overall cost to the Company by allowing us to exercise some control over the vendor as well as allowing us to "spin off" or license such technology if it is in our interest to do so. Technology management encompasses the need to maintain a qualified staff in the face of rapidly changing technologies, the availability of skilled scientists, and the need for effective communication to facilitate technology transfer and the commercialization of new products. New technologies are developing rapidly, and technology assessment and evaluation methods need to keep pace with the change. Personnel skill needs will also change rapidly, making highly trained worker skills obsolete in a relatively short period of time. Adequate training programs will need to be instituted to maintain skill competence in rapidly changing areas. In addition, utilization of outside sources of technology will need to be maximized to obtain key technologies without having to internalize expertise in the area. Intellectual property rights will become more important as novel technology-driven products become commercialized. Technology transfer involving effective communication among Research, Development, Engineering, Marketing, and Manufacturing will be essential to the successful commercialization of these novel products. Finally, as is widely publicized, the lack of availability of trained scientists in future years is expected to become a major issue for the country and the company. In certain disciplines, competition may be fierce, and defense-related skills may be preferentially acquired by the government. Finally, novel smoking articles and new product segments may lead to the obsolescence of our current products and/or processes. Many social/political factors are driving this process.

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Based on the consideration of PM USA's five-year goals and analysis of the future factors which will impact on the attainment of those goals, R&D's strategic goals for the 1991-1995 plan period are as follows:

1. **Support the company's present product lines and business operations.**
2. **Grow the business short-term with new/optimized products and processes for both domestic and international markets.**
3. **Address consumer wants and external requirements with new technology-driven products.**
4. **Grow the business long-term by identifying, evaluating, developing, and implementing new technologies potentially applicable to future products and business needs.**

Fourteen major programs are identified which support these strategic goals. Smaller programs either support the major programs directly (i.e. Menthol and Domestic Product Development) or form seed programs which may become a major program in the future (e.g. Combustion Research and Primary Improvement). Increased efforts over the plan period projected for Environmental Issues, and Selective Separations will most likely result in the attainment of major program status. Resources essential to the implementation of the R&D Five Year Strategic Plan are listed. Execution of the proposed programs are essential in order to increase volume and market share in our current environment.

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Introduction

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PLAN

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A. PM USA MISSION STATEMENT/GOALS

The Philip Morris USA Mission Statement

The mission of Philip Morris USA is continued growth--in volume, market-share, and income. To succeed we must have the best brands and marketing programs, the best people, quality products, and efficient, low cost production. We must encourage an approach to business where risk-taking, innovation and quick response are combined with financial discipline. Central to this mission is the defense of our right to market our products and of the adult consumer's right to enjoy them.

To fulfill this mission, we are committed to the following goals:

- *Build volume, market-share and profitability.*
- *Preserve and enhance the competitive spirit and commitment which make us the number one tobacco company in the USA.*
- *Employ superior people and provide a challenging work place that encourages, recognizes and rewards personal initiative.*
- *Earn the trust, respect and loyalty of our consumers, customers and employees.*
- *Create strategically sound long term plans and be committed to effectively implementing them.*
- *Develop technologically advanced facilities and products that service consumer desires and therefore meet customer needs.*
- *Manufacture the best cigarettes in the world and through marketing, let the world know we do.*
- *Fight for a social environment in which the adult choice to smoke is respected and our right to market is preserved.*
- *Be cost conscious and efficient in all aspects of business.*
- *Maintain the highest legal, moral and ethical standards in everything we do.*

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These goals and the five-year financial goals that follow form the basis for the development and implementation of the R&D strategic goals outlined in this plan.

PM USA Five Year Goals

The latest PM USA Sales Forecast outlined objectives for the next five year period. These 1995 goals are as follows:

<u>PM USA</u>	Volume		<u>Percent Change</u> <u>1991-1995</u>	Market Share	
	<u>1991</u>	<u>1995</u>		<u>1991</u>	<u>1995</u>
Total Full Margin:	190.8	185.3	-2.9%	37.6	40.7
Total Price Value:	30.5	40.7	+33.4%	6.0	8.9
Total PM USA:	221.3	226.0	+2.1%	43.6	49.6

Industry

Total Full Margin:	397.7	323.4	-18.7%
Total Price Value:	110.2	132.1	+19.9%
Total Industry:	507.9	455.5	-10.3%

These figures forecast a sales performance that significantly exceeds that of the overall industry. In addition, market share rises modestly in all categories over the next five year period. These goals can only be achieved with a proactive and aggressive response to marketplace demands. Strategies important to the achievement of these goals include the strategic completion of existing brand families; penetration into markets underrepresented by PM; the development of new market segments which provide benefits to consumers; and the development of products which address external requirements facing the industry.

B. R&D RESPONSIBILITIES

To support the Company mission and goals, R&D has three main responsibilities:

- **Support present product lines.**
- **Improve existing products and processes for both domestic and international markets.**
- **Develop new technology-driven products to satisfy future consumer wants and external requirements.**

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Status Review

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C. STATUS REVIEW

R&D supported work toward a number of key issues in the 1990-1994 Operations Plan. The issues and the R&D response during the past year are summarized below:

Government Regulations/Domestic:

Ignition Propensity - The Fire Safe Act of 1990 (Moakley et al.) was passed by Congress and signed into law by the President. Funding for this bill was approved in October, 1990. This Act provides for the development of a standard test method to determine cigarette ignition propensity, compilation of data using this test, and laboratory studies on computer modeling of ignition physics. The PM R&D actions pertaining to this issue involve the close monitoring of this Act and any future legislation relative to this issue, internal test development, modeling, product prototype development and support of the industry position.

Ingredients - The Waxman Bill was transformed into what was known as the Whittaker Bill. However, the Whittaker Bill is currently dead but will very likely be reintroduced in the Spring of 1991 by another member of the House Subcommittee on Health and the Environment due to Mr. Whittaker's retirement. The Whittaker Bill called for changes in the wording and appearance of warning labels, a variety of advertising restrictions, as well as the labeling of the top ten ingredients in each brand and the monitoring of ingredients by the Secretary of Health and Human Services. The Kennedy Bill also involves regulations relating to ingredients and advertising. More specifically, the current version of the Kennedy Bill establishes a Center for Tobacco Products as part of the Center for Disease Control, proposes to regulate ingredients and require food-type labeling, and deals with issues relating to advertising and sale to minors. Like the Whittaker Bill, the Kennedy Bill is dead in 1990, but will likely be reintroduced in the Spring of 1991. R&D's actions pertaining to this issue includes the close monitoring of this potential legislation, the management and reduction of the ingredients list, the Flavor Specification Program which is part of the Operations Support Program, and the investigation of alternate flavor systems. Significant progress has been made toward a net reduction in both the Philip Morris and Industry ingredients list as outlined in Table 1. The Flavor Specification Program involves the analysis of all flavors used by PM USA and the establishment of specifications with the appropriate vendor. Alternate flavor systems are formulated to assure quality and support flavor consolidation efforts whenever possible.

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Table 1
Ingredient List Reductions

PM	Date	Reduction from Previous Year	Cummulative Reductions
	1986	-11.4%	
	1987	- 7.1%	
	1988	- 5.8%	
	1989	- 7.0%	-28.0%
	1990 (Projected)	- 2.0%	

Industry	Date	Reduction from Previous Year	Cummulative Reductions
	1986	- 6.6%	
	1987	- 8.0%	
	1988	- 2.8%	
	1989	- 2.4%	-19.0%*

*Net Reduction: Some items added/some deleted.

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Government Regulation/Export

Tar, Nicotine and CO - During 1990, regulations or agreements have been instituted in Singapore (1.3 mg/cigt nicotine, 25 mg/cigt tar ($\pm 15\%$) maximum) and Australia (1.4 mg/cigt nicotine, 14 mg/cigt tar, 20 mg CO maximum). R&D actions that dealt directly with these situations involved the repositioning of twenty packings in Singapore and several packings in Australia. Other R&D actions directed toward this issue include the development of Tobacco Institute of Japan test methods for tar, monitoring the harmonization of the EEC in 1992, utilizing ART to adjust nicotine delivery where necessary, investigating CO catalysts for the reduction of CO in smoke, and our Low Tar/High Flavor Program.

Ingredients/Labeling - The following countries have cigarette-related regulations: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, Yugoslavia, Egypt, South Africa, and Tanzania. R&D actions/involvement dealing with the various changes necessitated by these regulations include monitoring the legislative situation in the various countries, ingredients list management and reduction to ensure the list meets the strictest regulation for each ingredient, certification of flavors on sheet materials in Germany, formulation of alternate flavor systems, monitoring the EEC 1992 harmonization, and pulling out of Canada when regulations were instituted requiring labeling by brand.

Capacity

R&D's role involves the development of new or improved processing methods. In addition, R&D supports product specification activities and the evaluation of product component changes. Specific activities include the Cast leaf Program, New Primary Process Program and product specification and standardization. Addressing capacity issues is a major objective of each of these programs.

Quality

R&D is involved in providing the capability to monitor visual, chemical and biological product specifications. R&D programs involved in this effort include Optical Processing, New Expanded Tobacco, Offset Printed Package Materials, Process Remote Sensing and Control, and components of Operations Support (Entomological Support, Microbial Quality Improvement, Adhesives/Flavor Specifications, Materials Evaluation and Customer Complaints).

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Cost Efficiency

The main R&D activity in this area involves the consolidation/simplification/substitution of product components wherever possible. Domestic activities involve the evaluation of wood pulp in paper; alternate filter tow and paper filters in selected products; and the standardization of filter configurations and specifications.

In the export market, R&D has been involved in evaluating blend consolidation possibilities. The different blends utilized for products currently marketed in Asia are listed below:

Japan:	L&M Parliament Mount Lark
Korea:	Lark Marlboro
Taiwan:	L&M Marlboro
Hong Kong:	Marlboro Marlboro Menthol Merit Mount

An evaluation of these blends indicates that there is no opportunity for blend consolidation with the current blends. Some small volume specials might be candidates for consolidation. R&D will evaluate the possibility of eliminating a tropical OV specification on cigarettes, especially 83 mm Box products.

Support of Established Product Lines

Through mainly our Domestic Product Development and International Product Support Programs, R&D has been involved in a number of support activities directed toward our current brands. These include: line extensions (Marlboro Menthol 83 Box, Alpine Full Flavor and Lights 83 Box, Bristol, Cambridge KS 6 mg); ingredients evaluation, reduction, and consolidation; Cambridge blend modification; evaluation of alcohol reduction in flavors (Project Grain); evaluation of wood pulp papers; repositioning Cambridge UL 100's from 5 mg to 6 mg; support for Bucks test market and national

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introduction; consumer panel testing; RL evaporator upgrade qualification; P&S dryer throughput qualification; carbon testing for Lark; combining wrap to improve efficiencies for Lark; Danchi Panels; Seoul Consumer Panel; and the Hong Kong Consumer Panel.

Environmental Regulations

The PM USA Operations Plan listed a number of objectives related to environmental issues which involved the support of R&D. These include the development of a comprehensive air emissions and solid waste management plan, the maintenance of compliance relative to all environmental regulations and the development of a proactive plan to address potential future regulations. Specific areas identified to receive attention include nitrates/phosphates in effluents, emission of CO₂ and volatile organic compounds, and product biodegradability. R&D has significantly increased involvement in the environmental area in the past year. Key activities involving R&D include the preparation of a draft of the five year Environmental Health and Safety Plan in coordination with E&EP, Engineering and R&D; evaluation of a 30% reduction in alcohol utilization in flavor systems (Project Grain) and the impact on product subjective (Cambridge POL); evaluation of heavy metals in inks and paper products; method development and evaluation for the disposal of nicotine generated from the ART process; support for the implementation of 100% Kabat® in order to eliminate the need for phosphine fumigations; evaluation of the potential to recycle sludge from the Park 500 waste water treatment facility as a pelletized fertilizer; effluent evaluation and process modifications initiated with the Cast Leaf Program; CO₂ emissions reduction as an objective of the New Expanded Tobacco Program; and product/packaging biodegradability evaluation. Biodegradability is not being pursued at this time because technology is not currently available which could achieve this goal and yet maintain product integrity. Furthermore, the solid waste of PM USA products represents a minor component (3%) of the PM Corporate product waste issue. In addition, R&D has ordered a hazardous waste compactor which will significantly minimize solid waste volume and the cost associated with the disposal of laboratory waste.

Modernization and Technology

The Operations Plan objective is to "...apply R&D results to advance the manufacturing process." Toward this objective R&D has been involved in a number of relevant activities in the past year. Optical inspection systems for print, web, and packs are currently under development as part of our Optical Processing Program. A second generation scrubbing system for the ART process is currently under development. Process development has provided new primary design support. In addition, two new major programs have been initiated in R&D to address capacity, quality and

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environmental issues associated with the RCB (Cast Leaf Program) and ET (New Expanded Tobacco) processes. In addition, the R&D Strategic Planning Committee, in conjunction with Senior Technical Staff in R&D, has undertaken an extensive review of in-house capabilities, technologies currently under development in-house, technologies available externally, and strategic technologies needed to accomplish goals and objectives. The information generated from this process is included in the appropriate sections of this plan. Finally, an action plan was developed (see Implementation Section and Appendix P) which provides a mechanism for the continued evaluation and implementation of technologies in our products, processes, and business operations.

Technology-Driven Products

An objective was assigned to R&D in the Operations Plan to "develop new high technology product concepts." R&D action on this objective during the past year has involved a large variety of technology-driven products. As part of the Low Tar/High Flavor Program, the specialized BOLD filter, a concentric filter with a paper core, allows for a high filtration and low pressure drop which results in increased impact and strength when tested relative to Now and Carlton. The Paper Technology Program has developed a paper which reduces sidestream smoke when used as a single wrap. The Virginia Slims Superslims product, which is currently under patent infringement litigation with B&W, may benefit from this technology. Project Sigma, development of a novel article with a chemical heat source, has been completed, and product evaluation efforts are underway. Many of the personnel previously working on Sigma are now assigned to Project Beta to form a Beta Team as outlined in the Beta Plan (See Appendix A). Project Ambrosia involves the development of a product with modified sidestream aroma that is superior to Chelsea and Horizon. In addition, products with reduced aroma and sidestream are being developed. Project ART technology has resulted in the development of products with most of the nicotine removed. In addition, products based on nicotine segmentation (Half-Nic) are currently under development. Finally, studies are underway to determine the optimum tar/nicotine ratios for nicotine segmented products.

Potential Future Technology-Driven Products

In the past year, efforts relating to future extensions of currently utilized and/or developing technologies have been initiated. For the ART process, future uses of this technology could involve the introduction of a variety of low nicotine brand extensions, utilization of ART material to meet nicotine delivery regulations, and potential introduction into the Japanese market. Other applications of ART technology could involve the removal or reduction of other tobacco components (i.e. TSNA precursors) and/or utilization for flavor impregnation to assist with flavor enhancement in Low

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Tar/High Flavor products. BOLD filters could be utilized on other products in the 3-5 mg tar delivery range to enhance strength and impact ratings. The evaluation of BOLD filters on an ART product may also yield a potentially successful combination of these two technologies. The use of BOLD-type filters to control filtration and "design" a product delivery system when coupled with blend, flavor and configuration modifications represents an opportunity to optimize low tar product subjectives. Finally, Project Ambrosia technology could be extended to include products with distinctive aroma and low visible sidestream, or products in which the sidestream aroma is masked or made neutral.

Summary

Based on R&D involvement in 1990 in these Operations Plan issues, an assessment has been made relative to the extent of our future support of these issues. Clearly, R&D will need to increase support of the environmental issues facing the Company, particularly in the area of developing a proactive position toward addressing potential regulations. In addition, the changes instituted by other departments to meet environmental goals will impact R&D in product support and evaluation areas and in the Operations Support program when qualification of changes relative to materials evaluation and product subjectives will be required. However, based on a thorough evaluation of the biodegradability issue, R&D support will be limited to monitoring the relevant technology as it becomes available. R&D Support for all other operations plan issues is expected to continue at the current level.

Internal Analysis

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D. INTERNAL ANALYSIS

R&D Programs

The 1990 PM USA R&D programs were formulated at the December, 1989, R&D Quarterly Planning Conference. The following major programs were approved for 1990:

1. Project ART
2. Project Sigma/Beta
3. Domestic Product Development
4. International Product Support
5. Operations Support
6. Paper Technology/Reduced Sidestream
7. Project Tomorrow
8. Optical Processing
9. Low Tar/High Flavor
10. Filtration Research
11. Cast Leaf
12. New Expanded Tobacco
13. Tobacco Specific Nitrosamines (TSNA)
14. Lowered Biological Activity (LBA)

One program, the Reduced Density Rod Program, was completed after a thorough evaluation indicated there were no clear product advantages for this technology at this time. Individuals working in this area changed focus to address pressing issues in the Cast Leaf and New Expanded Tobacco major programs which have been added as major programs in 1990. In addition, Project PACT, although not considered a major program relative to resource allocations, continued to receive R&D support. Project PACT relates to the development of efficient room air handling systems to minimize the effects of environmental tobacco smoke in public places. Significant progress was made toward its objective in 1990; therefore, R&D support toward this Corporate Affairs initiative is expected to continue to a lesser degree in 1991.

In addition to the major programs, a percentage of the R&D Staff is devoted to "other programs." These programs, which generally have only a few individuals assigned to each program, have two different functions. One group of programs includes small projects which are necessary to support our current business, whereas the second group involves long-term research efforts that are anticipated to develop into major programs in the future. These programs and their functional classification are shown in Table 2. It is important to stress that these "other programs" are as important to the fulfillment of

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Table 2

**Other Programs
1990**

Support Our Current Business

Ingredients
Menthol
Project Ambrosia
Reduced Tar and Nicotine International
Process Development Studies
Flavors
Project Natural
New Packaging Concepts (Tamper-Evident)
Process Control Systems
Project PACT
Environmental Issues

Long-Term Research Seed Projects

Selective Filtration
Combustion Research
Aerosols
Selective Separations
Consumer Testing Research
Chemical Senses
Biological
Computing Systems
Basic Analytical Research

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PM USA's R&D goals as are the major programs. All of PM USA R&D's programs are designed to support the PM USA R&D Strategic Plan.

R&D Resources

A comparison of R&D program direct resource allocations for 1989 and 1990 as a percentage of R&D staff is given in Table 3. Also given in Table 3 are the predicted resource allocations for 1990 which were estimated in 1989. The resource allocation process was computerized in 1990 to facilitate the input and sorting of the data and to ensure consistency in data handling processes. The automation of this process has allowed for more flexibility in the utilization of the data; therefore, allocations listed from 1990 on include both directly allocated and support resources in the figures assigned to each program.

Inspection of Table 3 indicates that only "other programs" and the two programs added in 1990 have significantly more resources allocated to them in 1990 than in 1989. The increase in "other programs" represents a small but significant increase in the evaluation of technologies that may enhance our efficiency and new product development efforts.

Significantly fewer resources were devoted to Project ART in 1990 than originally predicted in 1989. Quite simply, the additional resources that went to the two new programs, Cast Leaf and New Expanded Tobacco, account for the fewer resources in Project ART and Operations Support. The development of a product that would be competitive with RJR's Chelsea, as well as the capacity issues associated with the RCB and ET processes necessitated significant resource allocations to these programs. Project Sigma is to be completed in 1990 to allow for the shifting of resources to form the Beta Team (Appendix A).

International Product Support and Domestic Product Development received more resources than originally predicted. International sales, new markets in the Far East and Russia, and the need to modify products to meet a variety of government restrictions have led to a significant increase in the resources needed to meet these objectives. Also, Domestic Product Development was heavily involved in ART product development for 1990. In addition, more resources were allocated to the New Expanded Tobacco Program due to the time priorities involved.

Table 4 shows the actual number of personnel assigned to the R&D major programs. Resources were allocated to each program by the responsible manager based upon the best available information. The resources were then sorted by computer into the programs, and the Program Coordinators were asked to review the resources allocated to their programs during the plan period. In some cases, such as the Tobacco Processing

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Table 3
Comparison of Resource Allocations
1989-1991

	1989 (Actual) (%)	1990 (Actual) (%)	1991 (Estimated) (%)
Project ART	14.5	10.9	7.9
Project Sigma/Beta	9.2	8.0	6.4
Domestic Product Development	12.7	13.1	13.2
International Product Support	9.5 ¹	10.5 ¹	10.5
Operations Support	14.7	14.3	14.2
Paper Technology/Reduced Sidestream	10.6	8.2	7.9
Project Tomorrow	1.2	1.7	3.3
Optical Processing	1.4	1.3	1.4
Low Tar/High Flavor	2.2	2.1	2.3
Filtration Research	3.0	1.9	1.5
Reduced Density Rod	4.5	—	—
Cast Leaf	—	2.1	3.0
New Expanded Tobacco	—	5.2	8.0
TSNA	4.7	4.3	4.0
LBA	2.9	3.2	2.4
Other Programs	8.8	13.2	14.0

1. Includes QZ Personnel

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and Fabrication Division (Semiworks), resources were directly allocated to each major program based upon the percentage of requests from each major program. In other cases, such as the Computer Applications Division, resources were allocated as support according to the division or program headcount. Table 4 shows the 1990 resource allocations for R&D programs giving direct resources, support, and total resources.

Both Operations Support and Other Programs are composed of a number of small projects. Projects included under Operations Support are shown in Table 5 along with allocated resources. Projects included under Other Programs and their resource allocations are shown in Table 6. As already pointed out, the number of resources allocated for Other Programs has increased in 1990. The increase is spread out among many divisions and represents an increased involvement in virtually all divisions in Other Programs.

PM Europe R&D

An additional internal resource to PM USA is PM Europe R&D. A copy of the PM Europe Strategic Plan is included in Appendix B. Highlights of that plan are summarized below.

There is considerably more emphasis in the Philip Morris Europe R&D 1991-1993 Strategic Plan on government regulations than there has been previously, particularly with respect to environmental concerns and compliance with emerging product legislation. The Product Development Department has been charged with developing and implementing a program in order to reduce tar deliveries of all brands if needed to ensure compliance with the 1993 EEC tar ceiling regulations. In addition a long-term plan will be developed with the objective to further reduce tar deliveries to be in compliance with the 1997 EEC tar ceiling regulations. The Research Department will maintain and continue to upgrade the monitoring program for chemical constituents in all materials going into the fabrication of a cigarette so as to be in complete compliance with specific laws within PME. They have also been charged with centralizing and computerizing, in cooperation with PM USA, information regarding legal situations and requirements in the fields of pesticides, additives, and packaging materials for all EEC and EEMA markets, in order to be able to immediately react to legal changes.

Product quality continues to be a major issue. The Quality Assurance Department will concentrate on programs which will result in product quality improvements. These programs include rating of suppliers, training of QA personnel in affiliates and licensees, and improved supervision of sanitary conditions of leaf purchases. An improved and standardized European system for the evaluation of consumer complaints will be

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Table 4

Total Resource Allocations for PM USA R&D Programs
Calendar 1990
As of October, 1990
(Numbers of individuals^{1, 2})

	Direct	Support¹	Total	%
Project ART	48.6	18.9	67.5	10.9
Project Sigma/Beta	35.8	13.9	49.7	8.0
Domestic Product Support	58.5	22.7	81.2	13.1
International Product Support ²	58.1	6.6	64.7	10.5
Operations Support	63.4	24.6	88.0	14.3
Paper Technology/Reduced Sidestream	36.6	14.2	50.8	8.2
Project Tomorrow	7.6	3.0	10.6	1.7
Optical Processing	5.8	2.2	8.0	1.3
Low Tar/High Flavor	9.4	3.6	13.0	2.1
Filter Research	8.5	3.3	11.8	1.9
Cast Leaf	9.4	3.6	13.0	2.1
New Expanded Tobacco	23.2	9.0	32.2	5.2
TSNA	19.2	7.4	26.6	4.3
LBA	14.4	5.6	20.0	3.2
Other Programs	58.3	22.6	80.9	13.2
	456.8	161.2	618.0	100.0

1. Includes 43 executive and administrative personnel

2. Includes 41 QZ personnel

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Table 5

**Distribution of Directly Allocated Resource Allocations
for the Operations Support Program
1990**

	No. of Personnel	%
Environmental Compliance/Mono Inks	3.9	6.2
Semiworks Support	17.2	27.2
Entomology	6.3	9.9
Alternate Humectants/Preservatives	5.3	8.4
Materials Evaluation	8.3	13.1
Customer Complaints	1.8	2.8
ETS	2.1	3.1
Flavor Specifications/Certifications	7.1	11.2
Cigarette Monitoring	1.5	2.4
Micro Quality Improvement	2.7	4.3
Burley Spray/Dry Flavors	0.5	0.8
Flavor Development/Analytical Support	1.8	2.8
Cooperative Leaf Studies	1.5	2.4
Project Warhol	0.7	1.1
Engineering Studies/Methods	2.0	3.2
Recon Sheet Certification	0.7	1.1
Total	63.4	100.0

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Table 6
Distribution of Directly Allocated Resources
in Other Programs
1990

	No. of Personnel
Project PACT	2.8
Project Natural	1.5
Environmental Issues	5.5
Ingredients	2.0
Menthol	6.0
Project Ambrosia	7.4
Reduced Tar and Nicotine, International	1.7
Selective Filtration	1.4
New Packaging Concepts	0.2
Process Development Studies	1.9
Combustion Research	0.6
Flavors	6.0
Aerosols	4.6
Selective Separations	2.4
Consumer Testing Research	2.5
Chemical Senses	1.8
Measurement and Sensing of Physical and Chemical Character (Process Control Systems)	2.5
Biological	3.2
Computing Systems	2.8
Basic Analytical Research	1.5
Total	58.3

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developed and used as a quality management tool. This last assignment will be carried out in conjunction with Sales and Marketing.

Emerging technologies which will have emphasis include a new triple tube-in-tow filter, which significantly flattens the puff-by-puff profile, and total blend expansion. Considerable work will be done on filters for low delivery products including concentric filters, tobacco sheet filters, and CA-web filters.

Considerable priority will be placed on consumer research. In a combined effort with Marketing Research France, a new questionnaire, to be used in Product Test Research, has been developed and successfully tested. A study, using the French market as a model, was initiated and conducted with the objective of correlating market dynamics, measurable product parameters, and subjective attributes based on sensory evaluation. The outcome of this study will provide a better and more accurate understanding of consumer perceived product performance.

A major responsibility for the Process Development Department during the next few years will be to focus on capacity issues. A capacity increase program for primary processing equipment will be implemented in coordination with the PME affiliates. A number of engineering projects are planned, including the primary extension and the new ET plant in BOZ, the installation of LEGG driers in Berlin, the BBS processing and cut filler pack-out in Munich, the separate ET line in FTR Onnens, and the FTR primary improvement program.

Technology Review

Technological information and capabilities available to PM USA R&D come from many sources. Maximizing the efficient utilization of all of these sources is associated with the maintenance of a competitive position in this fast moving area and is essential to the development of proprietary technology driven products. A thorough review of all sources of technology currently available to PM USA R&D is listed in Appendix C. More specifically, the following compilation will be found in Appendix C:

1. Areas of Particular PM USA R&D In-House Expertise
2. PM USA R&D Collaborative Research Programs - 1990
3. Consulting Relationships - 1990
4. Visiting Scientists - 1990
5. Science and Technology Areas Currently Under Development at PM USA R&D
6. Technology Assessment

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In 1990, the PM USA R&D Strategic Planning Committee, in conjunction with senior technical staff, undertook a thorough review of technologies currently available to R&D (Appendix C), technologies developing externally (Analysis of Future Factors Section and Appendix D), the technology needs of R&D programs or Strategic Technologies (Analysis of Future Factors Section and Appendix E), and an Action Plan (Implementation Section and Appendix P) on handling technology evaluation in the future.

R&D Patents and Publications

During the period July, 1989 to July, 1990, a total of 23 tobacco-related patents were granted to Philip Morris, Incorporated by the United States Patent and Trademark Office. In addition, patents were granted to Filter Materials Limited (1); Fabriques de Tabac Reunies, S.A. (FTR) (1); and one design patent to FTR. Three defensive disclosures were published during the past year. Defensive disclosures are generally pursued for subject matter when Philip Morris wants to maintain the right to use but does not necessarily want to preclude others from using.

Areas in which Philip Morris demonstrates technology leadership, as evidenced by its issued patents, include: make/pack improvements (7 patents); optical processing (5 patents); cigarette pack technology and design (5 patents); and flavor synthesis (4 patents). Three filter-related patents and two product/process patents were also granted.

Issued patents, by title and technology category, are listed below. The first page of each patent may be referred to in Appendix F.

1. Filter Technology

USP 4,848,375 - Filter Cigarette

USP 4,869,276 - Hinged Filter Sleeve

USP 4,925,602 - Method for Improving the Crimping of Polyolefin Filter Tow
(Filter Materials Limited)

2. Flavor Synthesis Technology

USP 4,859,775 - Process for Preparing Acylpyrazine Ethers

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USP 4,872,917 - Sclaral Alkyl Ethers and Smoking Compositions Containing a Sclaral Alkyl Ether Flavorant

USP 4,872,918 - Heterocyclic Esters and Smoking Compositions Containing a Heterocyclic Ester Flavorant-Release Additive

USP 4,925,985 - Process for the Production of 4, 6-Dimethyl-7-Hydroxynonan-3-one

3. Packaging Technology

USP 4,843,801 - Method and Apparatus for Opening Closed Containers (Pack Opening Device)

USP 4,850,482 - Cigarette Box Innerframe

USP 4,923,059 - Hinged-Top Cigarette Box

USP 4,938,363 - Outer Wrapper Containing an Integral Tear Tape

Design Patent 303,722 - Pack for Cigarettes (Fabriques de Tabac Reunies, S.A.)

4. Make/Pack Technology

USP 4,850,749 - Airlock Having Flaps in Continuous Feed of Material Carried by a Gas Stream While Obstructing Free Flow of Gas

USP 4,875,495 - Separation of Light Particles from Heavy Particles in a Stream of Particulate Matter

USP 4,895,603 - Apparatus and Method for In-Place Cleaning and Priming of a Nozzle Assembly (Glue Nozzles)

USP 4,911,028 - Apparatus for Automatically Stripping Sheet Material From a Bobbin

USP 4,911,374 - System and Method for Use in Delaminating Bobbins for Paper Material

USP 4,932,423 - Tobacco Feeding Apparatus (Fabriques de Tabac Reunies, S.A.)

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USP 4,934,624 - Robotic Hand

5. Optical Processing/Quality Measurement Technology

USP 4,890,053 - Method and Apparatus for Detecting a Missing Object in a Set of Objects

USP 4,906,099 - Method and Apparatus for Optical Product Inspection

USP 4,928,181 - Methods and Apparatus for Optically Enhancing Selected Features in an Input Image

USP 4,930,344 - Apparatus for Testing the Quality of a Seal on a Package Overwrap

USP 4,942,363 - Apparatus and Method for Measuring Two Properties of an Object Using Scattered Electromagnetic Radiation

6. New Products/Processes

USP 4,874,000 - Method and Apparatus for Drying and Cooling Extruded Tobacco - Containing Material

USP 4,936,920 - High Void Volume/Enhanced Firmness Tobacco Rod and Method of Processing Tobacco

7. Defensive Disclosures

Pinned Feeder Cleaning Arrangement

Bulk Tobacco Handling System for Transporting Tobacco Between Facilities

Improved Pneumatic Separator

As of July 1, 1990, there were 86 patent applications (assigned to P.M., Inc.) pending in the United States Patent and Trademark Office. During the past year, a total of 27 new applications were filed and one each divisional, continuation and continuation-in-part were filed. Patent activity should escalate during this plan period due to the large number of disclosures being submitted, as well as the addition of one patent attorney to the Corporate Patent Group.

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Expedited review of new invention disclosures by R&D management jointly with Engineering management on a monthly basis coupled with an accelerated filing effort by the Patent staff and outside attorneys should result in a stronger patent position for P.M., Inc. in the near term (i.e., two to three years out). Sustained effort is required to ensure adequate protection of P.M., Inc.'s proprietary/intellectual property as well as its right to produce and market new technology-driven products.

Research findings for which patent coverage is not pursued are generally published in scientific journals and/or presented at scientific meetings and seminars. During the past year, 25 papers were authored by R&D personnel and published in appropriate scientific journals. Many of the published papers reflect R&D's collaborative research efforts with outside universities and consultants and are representative of the varied fields of expertise of the R&D staff and the department's contacts with scientific investigators throughout the world. Subject matter published ranges from physics/physical chemistry (7 papers) to cell wall and biotechnology research (6 papers) to papers on the science of sensory perception (4 papers). A listing of published papers by category, titles and authors is compiled in Appendix F.

Technical Synergy

Status - The diversification of Philip Morris Companies has created the possibility of improving the effectiveness of the individual operating units through a number of synergies. One of these is technical synergy. In order to take advantage of potential areas of R&D overlap, a technical synergy effort was initiated in July, 1988, by the Research Vice Presidents of the operating companies. The goal of the group was to leverage the Corporation through joint/coordinated research activities in order to minimize duplication. The results of the effort have been many. The most important has been the establishment of an informal network of contacts between technical personnel within the operating companies. Catalogs have been established of existing technologies, emerging technologies being tracked, external resources utilized, and facility capabilities. A comprehensive evaluation of our competitors' research personnel, facilities, and activities has been developed and maintained. More applied results of this effort include numerous examples of successful technology transfer between operating units, several instances of joint technical problem solving, the Technical Symposium program, and exchanges of personnel.

In the past year, Technical Symposia have been held on Process Development, Packaging, and Preservation. A symposia on Product Development processes will be held this winter in Glenview, and a workshop and symposium on Microbiology is being organized by Company-wide microbiologists as a spin-off of the Preservation Symposium.

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In addition to the many technical exchanges occurring between the Operating Companies of PM Companies, Inc., specific longer term personnel exchanges have taken place to exchange knowledge, communication, and technical synergy. Dr. F. del Valle, of General Foods, spent approximately eight months at PM USA R&D in 1989. In exchange, Dr. Walter Hempfling of PM USA R&D spent approximately five months in 1990 at the General Foods Central Research Facility in Tarrytown, New York. Dr. Hempfling's visit included extensive tours of the many and varied General Foods processing facilities. In addition, plans have been made for Dr. Hempfling to visit KGF at Glenview for approximately one month in 1991.

Specific technical exchange with the Miller Brewing Company is currently in progress. Dr. Patricia Bower of the Miller Brewing Company is functioning as a Visiting Scientist in the Biochemical Research Division of PM USA R&D. Dr. Bower's expertise in molecular genetics will be utilized in the Biochemical Alteration of Tobacco objective of the TSNA program. In addition, the facilities of the project, some of which are not readily available at Miller, will be utilized by Dr. Bower to complete a research project for the Miller Brewing Company.

Internal Analysis Summary

PM USA R&D Internal Strengths derived from this internal analysis are listed in Table 7. Internal Issues are listed in Table 8. Each Internal Issue has a corresponding action plan. These action plans are discussed in the Implementation Section of this plan and/or Appendix P.

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Table 7

Internal Strengths

- Broad scientific base augmented by recent new hires.
- Rapid response to short-term goals.
- Good short-term operational plans.
- Well-placed university contacts.
- Money available for justifiable programs.
- Considerable multi-divisional interactions.
- Good understanding of conventional cigarette construction.
- Technically strong staff.
- R&D programs focused.
- Planning oriented toward business objectives.
- Improved effort in alerting outside groups early with respect to technology transfer issues.
- Increased developmental opportunities because of a more flexible organization.
- Increased interaction with other PM Companies.
- Improved financial planning.

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Table 8

Internal Issues

1. Technology Management

Key dimensions of this issue include:

- Technology Assessment
- Personnel Skills/Mix/Change/Availability
- Training
- Utilization of External Resources/Suppliers
- Synergy
- Protection of Intellectual Property Rights
- Technology Transfer/Commercialization of Non-Traditional Products
- Communications

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E. EXTERNAL ANALYSIS

Industry Highlights

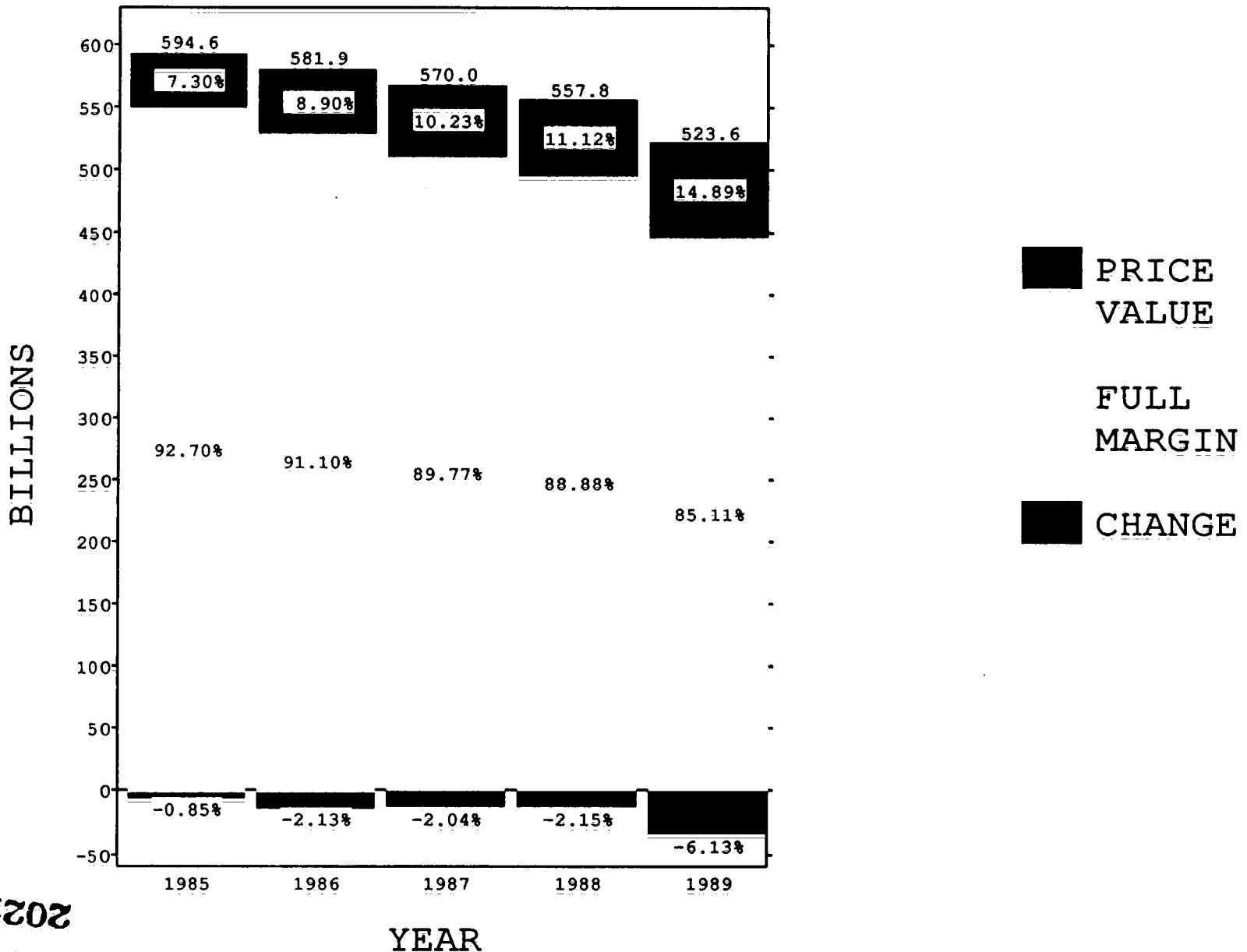
Key historical information on industry and PM USA volume and market share, as well as the market share and share change of the top ten brands is provided in Figures 1-5. From 1988 to 1989, there was a 34.2 billion or 6.1% unit decrease in volume (Figure 1). This relatively large decline has been determined to result from three factors: the base decline in market, -2.8%; state excise tax increases (7% in California), -1.0%; and RJR's no load action in 1989, -2.3%. Therefore, the industry would have declined by only 3.8% if RJR had not stopped trade incentives in 1989. In addition, the price/value segment grew by 16 billion units or 25.8% in 1989. Figure 2 summarizes industry market share changes from 1988 to 1989. PM USA increased 2.6% to a 1989 market share of 41.9%. Logically, some of PM's market share gain resulted from RJR's large decline (-3.3%) due to their no load decision in 1989. If RJR had decided not to take this action, the PM USA market share for 1989 was projected to be 40.9%. A summary of the market share changes for each Company and the major determinants of that change are listed below:

PM USA	+2.6%	Marlboro Lights/Cambridge
RJR	-3.3%	All brands declined except Doral and Magna
B&W	+0.5%	Viceroy and Richland 20's
Lorillard	-0.3%	All brands declined except Newport
American	--	No change
Liggett	+0.5%	Pyramid gained; Generics lost share

An analysis of Figure 3, PM USA volume, indicates that full margin brands declined (4.7 billion units) at a slower rate than the total industry decline rate. PM USA price/value brands increased 4.9 billion units, due to Cambridge (+2.1) and Alpine (+2.8) volume increases. PM USA market share figures are shown in Figure 4. The top ten brands in the industry and their market shares are given in Figure 5. Rank order has not changed relative to 1988, and Cambridge now rates 13th in sales with a 2.3% market share.

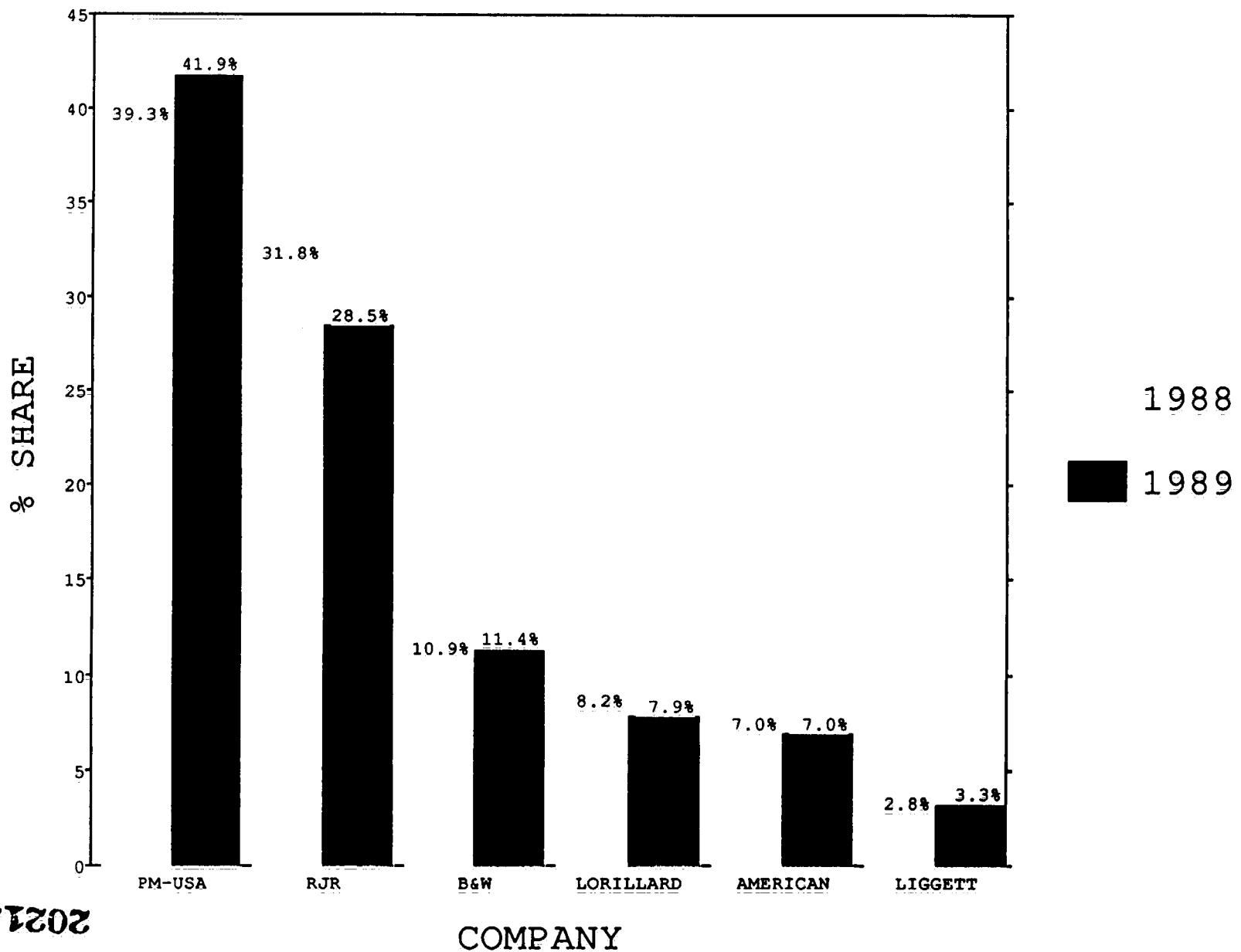
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Figure 1
INDUSTRY VOLUME



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Figure 2
INDUSTRY MARKET SHARE



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Figure 3
PM-USA VOLUME

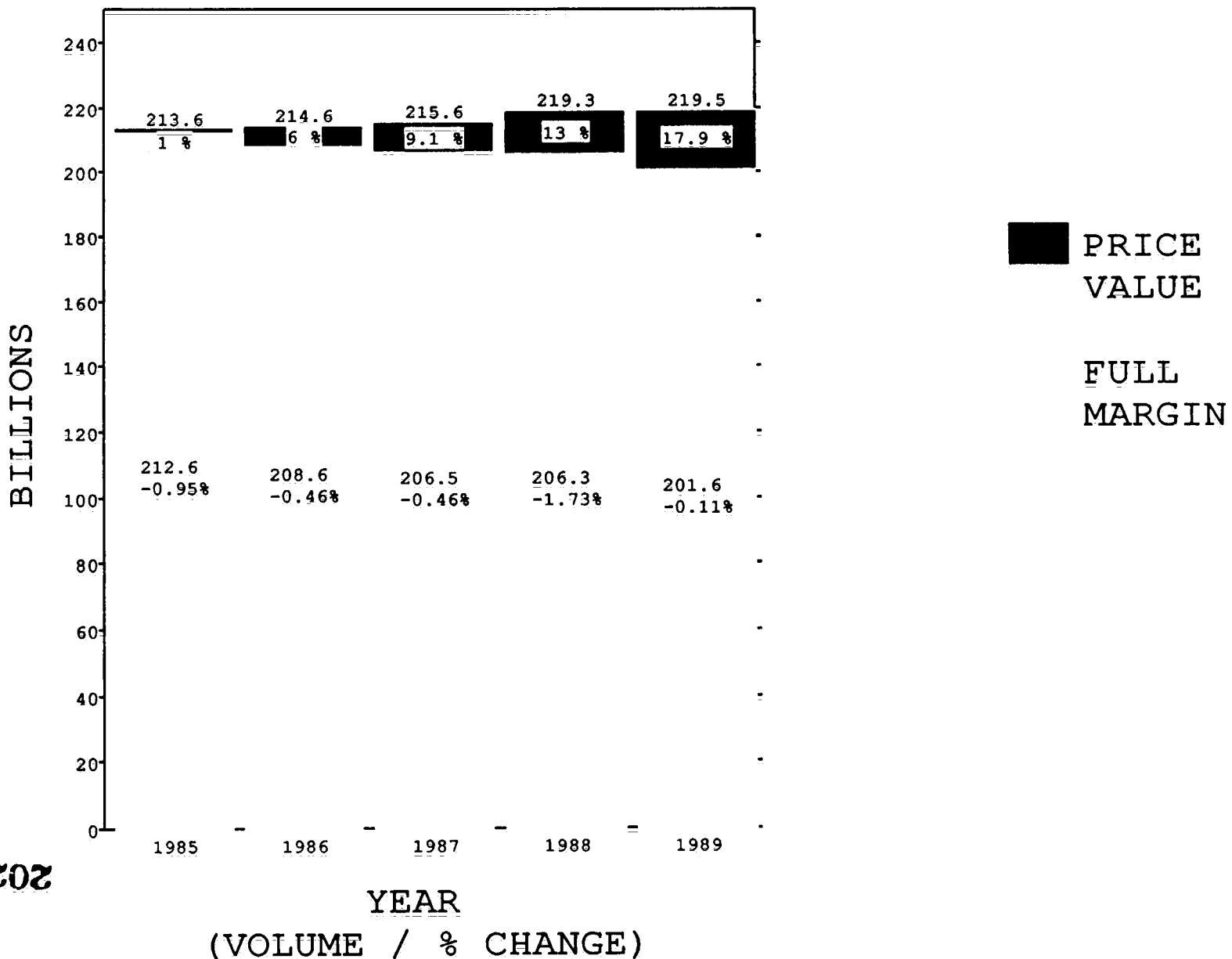
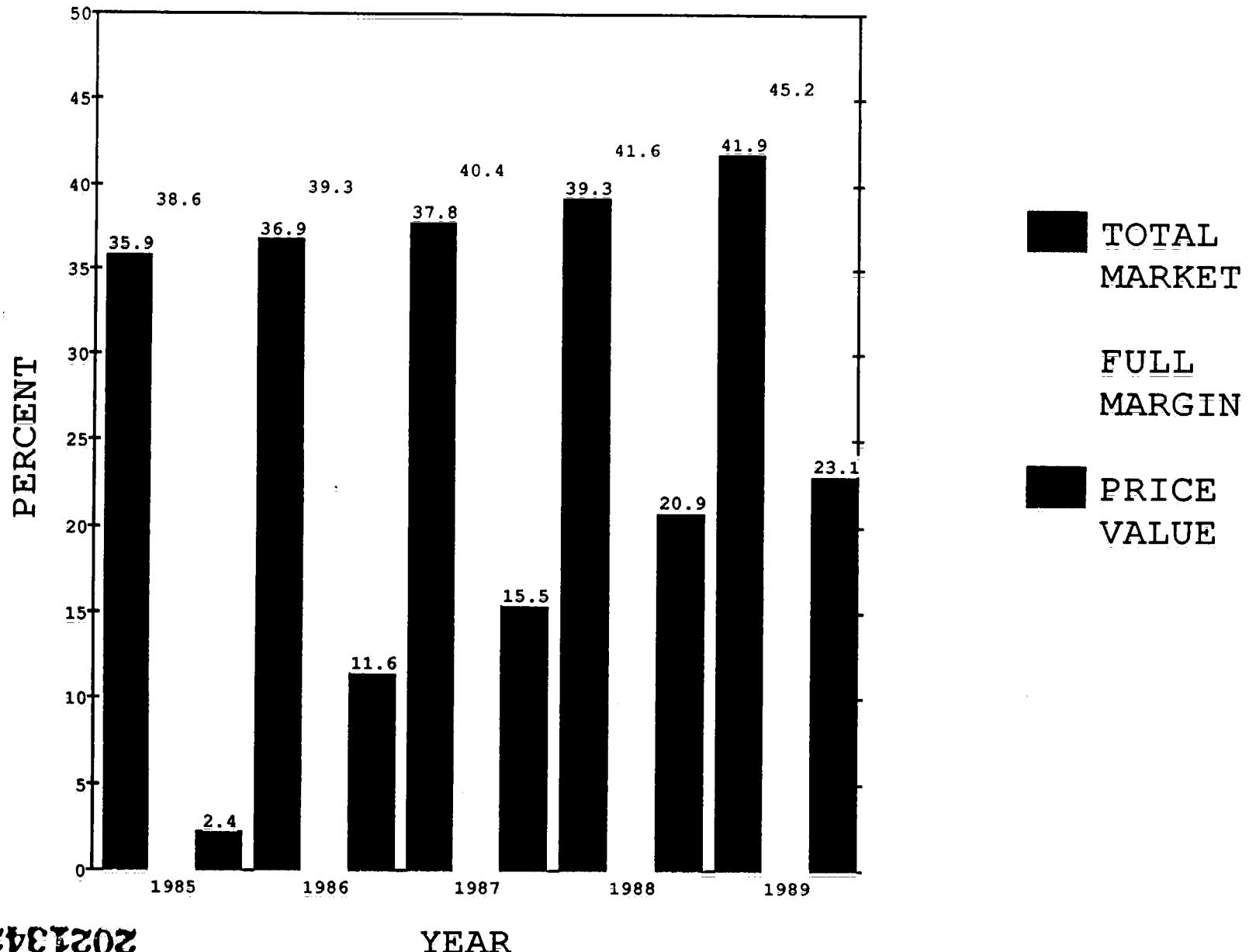
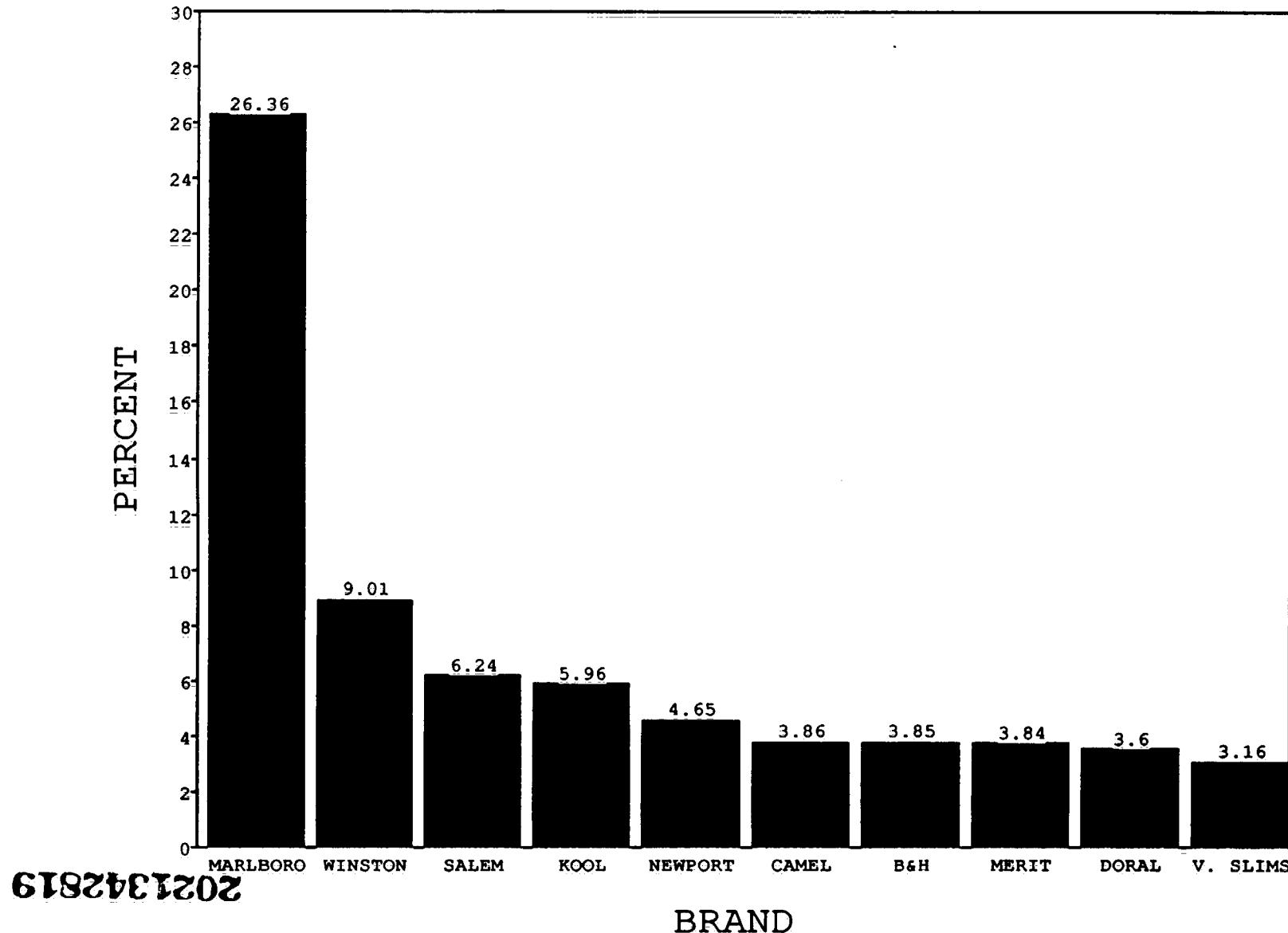


Figure 4
PM-USA SHARE



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Figure 5
TOP TEN BRANDS
1989 MARKET SHARE



Competitive Analysis

Our major competitors, both domestic and worldwide, have not changed since the preceding year; namely, RJR Tobacco, Brown and Williamson (BAT), and Japan Tobacco (JTI). All three remain active competitive threats. Information for each of these three companies will be summarized separately. Topics to be discussed will include new product introductions, R&D organization, patents and publications, and any information we may have which reflects on strengths and weaknesses.

RJR TOBACCO

RJR Highlights - As in 1989, RJR has generated more than its share of controversy during 1990. Early in the year RJR unveiled its plan to test market Uptown in Philadelphia, a brand that was admittedly targeted to black smokers. The reaction from black leaders on both the local and national level was swift and unexpected. RJR was severely criticized in the press for targeting a cigarette to a group which already was suffering disproportionately from health problems. RJR bowed to the pressure approximately one week later indicating that they were withdrawing the product from test market, since it would be impossible to obtain meaningful data from the test market relating to product performance. Not long thereafter a new controversy erupted over a second product to be test marketed by RJR. The product was Dakota, and the problem arose when a memo written by an advertising agency which referred to the new product as "Project Virile Female" was leaked to the press. The memo indicated that this new product was to be targeted at young females with a low socioeconomic status. The description of this group by the advertising agency was hardly complimentary. RJR weathered this particular storm and went ahead with their test market. The controversy has since apparently died down, although protests by groups within both North and South Dakota are continuing because of the name.

A major highlight of the year was RJR Tobacco's decision not to load at the end of 1989. This decision led to a significant decline in 1989 volume and market share for RJR. Volume declined by 27.8 billion units (15.7%) and market share by 3.3 share points. Although we have no information as to what the decline would have been without Reynolds' change in policy, business unit contribution from tobacco was up 5.2% compared to 1988, while it is estimated that it would have been increased by 27% had loading been continued. As might be predicted, RJR's market share will improve in 1990. For the twelve month period from October 1989 to October 1990, RJR had a market share of 29.6% compared to a 28.5% share in the calendar year 1989.

Despite these problems, RJR appears to remain financially sound. They have met their interest payments with few apparent problems, and have reduced debt on schedule

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through the sale of a number of companies primarily in the food area. The specific companies divested in the past twelve months are listed in Table 9. In addition they are continuing to pursue cost savings options in an aggressive manner. The last phase of the personnel cutbacks initiated in 1989 occurred on January 17, 1990, when RJR announced the layoff of 50 engineers and supervisors. That a significant reduction in force has actually occurred in Winston-Salem is apparently obvious to the town's citizens in that there have been complaints that RJR could donate their excess parking spaces in the downtown area to employees in the Wachovia and Phillips buildings.

On the other hand RJR continues to investigate every possible approach to reducing its costs. During 1990 weight reductions were made in thirteen additional brands. These reductions ranged from 2 to 8%. RJR is also putting considerable pressure on its suppliers to keep costs down. The number of brands which utilize 50% flax/wood pulp paper have been extended. In 1989 the only packings which had been affected were the price value brands Doral and Century. In the second quarter of 1990 all packings of Magna were changed over to 50% flax/50% wood pulp paper as well as two packings of Camel and six packings of Winston. In order to lower its enormous debt payment, RJR announced a refinancing program in July whereby corporate debentures due in 2007 and 2009 would be repurchased. These two debt issues are a particular thorn in RJR's side, since they carry the stipulation that the coupon rate must be adjusted in 1992 to bring the bonds back to par. Sources for the necessary capital include \$2.25 billion in new bank loans and additional \$1.7 billion in equity from KKR. The requisite bank loans were obtained with no problems in part because of generous fees being paid to several major banks by RJR. On the other hand, attempts by the major banks to "farm out" \$1.2 billion of the loan to smaller banks have resulted in the placement of only \$200 million at this time. In mid July the coupon rates of these two issues was increased from about 14% to about 17% increasing the trading price to about \$95 for \$100 face value. RJR has since bought back a large amount of the 2007 bonds. On Thursday, August 2, with the bond market in disarray as a consequence of the Iraqi crisis, RJR bought back an estimated \$800 million to \$1 billion of the bonds at prices ranging from 90 cents to 95 cents on the dollar.

RJR has done an excellent job with the Tobaccoville facility. They have been able to reduce manufacturing costs as a consequence of increased efficiency and a decreased labor force. This increased efficiency has been accomplished without any loss in quality. In reality RJR has emphasized quality improvement during the past two years, and the substantial advantage PM enjoyed over RJR with respect to product quality has significantly narrowed.

Despite the many measures RJR Tobacco has taken to remain a strong factor in the US cigarette market, some financial experts think that further cost cutting measures must be

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Table 9

Companies Divested by RJR Nabisco since June, 1990

Chun King (remaining business) - Sold to Singapore consortium of Yeo Hiap Seng Ltd. and Fullerton Holdings Pte. Ltd., 6/89.

European food businesses (UK Nabisco Brands, Walker's Crisps, Smith's Crisps, Belin Group, Saiwa) - Sold to BSN Groupe, Paris, 6/89.

Associated Biscuits International (India, Pakistan) - Sold to Britannia Brands Pte. Ltd., 7/89.

Del Monte Corp., fresh fruit and vegetable operations including trademark - Sold to Polly Peck International, 8/89.

Del Monte Corp., canned food and processing operations - Sold to Citicorp, 9/89.

Baby Ruth, Butterfinger, Pearson candy businesses - Sold to Nestle, 10/89.

Hawaiian Punch - Sold to Proctor & Gamble, 1/90.

Nabisco food businesses in New Zealand, Singapore, Malaysia, Hong Kong - Sold to Britannia Brands Pte. Ltd., 3/90.

Brazil cigarette business - Sold to Dibrell Brothers, 3/90.

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taken in order for RJR to continue to meet debt repayment schedules. An article in Barron's (July 9, 1990) indicated that RJR must cut budgeted capital spending for 1990 by \$50 million. This article points out that further spending cuts may in turn result in further loss of market share resulting, eventually, in a downward spiral.

RJR Domestic New Product Introductions - Uptown, already mentioned above, was planned to be test marketed in Philadelphia in January, 1990. The product was to have been sold as two packings of menthol only - 80 mm box and 85 mm soft pack. Delivery targets were 17 mg tar, 1.2 mg nicotine, and 0.6 mg smoke menthol. One interesting feature of these cigarettes was that they were to have been packed with the filter end toward the bottom of the pack.

Salem Gold 85 cigarettes were introduced nationally in March, 1990. These cigarettes deliver 17 mg tar, 1.2 mg nicotine and 0.2 mg smoke menthol.

Dakota 80 (box) and Dakota Lights 80 (box) are being test marketed in Texas and Tennessee as of March, 1990. The Dakota cigarette delivers 17 mg tar and 1.1 mg nicotine, and the Dakota Lights cigarette delivers 12 mg tar and 0.9 mg nicotine. As already discussed this product is targeted toward young women.

Salem 80 (box) cigarettes were reintroduced in Chicago, Illinois, in May, 1990. This brand delivers 17 mg tar, 1.1 mg nicotine and 0.5 mg smoke menthol.

Horizon cigarettes (regular and menthol) have been test marketed in Georgia since June, 1990. This brand delivers 12 mg tar and 0.8 mg nicotine. This product uses a glycoside of ethylvanillin to modify the aroma of sidestream smoke. It is similar to Chelsea in that both products utilize the same flavor-release compound coated on cigarette paper. The differences are that Horizon is a full circumference cigarette whereas Chelsea is a slim cigarette (23 mm), and Horizon uses a 0.8% level of the flavor-release compound on the paper compared to 0.6% for Chelsea. It is worth mentioning that the flavor-release compound being used in these two products is apparently being produced by RJR's Avoca Division. To our knowledge RJR is the only tobacco company with captive facilities for the synthesis of tobacco flavors. The Avoca Division was originally established either in the late 1960's or early 1970's to grow clary sage as a source for scleral type terpene flavorants. We know that in 1980, Brian Lawrence, now Manager of Flavor Technology at RJR Tobacco R&D, was Director of Research and Development at Avoca. Recent information indicates that RJR still has 1000 acres devoted to the growth of clary sage and facilities to extract sclareol which is in turn converted to sclareolide. This facility is located in Pamlico Sound, NC. RJR has also started to grow experimental plots of low alkaloid tobacco via a standard breeding program at the same site.

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RJR is actively continuing product development on their Premier product. We have discovered that they had been negotiating with groups within the German government in order to obtain approval to market Premier in Germany. It would appear, however, that RJR has no plans to market Premier in Germany in the near future.

RJR R&D Organization - During the previous two years the RJR Tobacco R&D staff has decreased by about 17%. In 1988, before the buy-out, the R&D staff was about 800 individuals. This number is now about 650-670. Most of those who were "let go" were early retirees (willing and unwilling), technicians and "low level performers." We are aware of four "high level" individuals who have either been terminated or have retired during this two year period. Don Roberts was Director of Brand R&D in 1988. He was replaced in this position by R. L. Willard in July, 1988, and terminated in August, 1989. Anthony Colucci, Director of the R&D Law Department, retired in 1988 and is now a consultant. Charles Nystrom, Manager of Scientific Affairs, was terminated in August, 1989. Lastly, Claude Teague, Director of R&D Administration, retired in 1988. A number of key scientists who have left include Jim Arnett, Senior Scientist in the agronomy group, Robert Moates, Scientist in the organic chemistry group, and K. W. White in the optical technology group. Dr. White, who was apparently the project leader of the optical technology group, resigned in 1989, but continues to consult for RJR.

Some recent information calls into question our estimates of RJR's R&D headcount. The estimate given above is derived from information contained in the "Directory of American Research and Technology, 1990." This information, however, is reported by RJR personnel. Another source indicates that RJR's headcount is 980. We are currently in the process of investigating this discrepancy.

RJR's R&D Organization has undergone some change from last year. F. H. Christopher, formerly executive vice president, Manufacturing and Technology, has recently retired. Bob DiMarco remains as Senior Vice President of R&D and now has five Vice Presidents reporting to him instead of four. The Biological R&D group has been split in two. One part retains the title Biological R&D, and A. W. Hayes continues as its Vice President. The second area is titled Toxicology R&D, and the Vice President is G. T. Burger. Biological R&D has four directorates - Biobehavioral Research, Environmental Tobacco Smoke, Sensory Evaluation and Smoking & Health - while Toxicology R&D has three directorates - Biochemistry/Microbiology, Pharmacology Research, and Toxicology Research. The remainder of the organization remains unchanged with M. E. Stowe as Vice President, Product and Applied Technology, R. A. Lloyd as Vice President, New Product Technologies, and W. M. Hildebolt as Vice President, Administrative and Technical Services. The RJR R&D Organization Chart is included as Appendix G. Along with the organizational chart is a complete list of every individual we have identified as being in RJR R&D. Some of these are not included in

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the organizational chart itself, either because they have since left RJR R&D, or because we do not know what group to place them in.

RJR Patents and Publications - During the twelve month period between June, 1989, and June, 1990, RJR Tobacco had 40 issued US patents, 2 German patents, and 4 European Patent Office (EPO) applications. This represents the largest number of patents for RJR for the four year period that we have been closely monitoring RJR's patents. These patents cover a wide range of topics as can be seen from inspection of Table 10. Several of these patents are of strategic importance. At the top of the list are two patents US 4,947,874 and US 4,947,875) which describe smoking articles which utilize electrical energy. Two German patents (DE 3,844,620 and DE 3,821,677) teach a system of applying flavor solutions to tobacco at the maker. The system described allows the flavor solution to be added to the center of the cigarette being formed. Two other patents deserve special mention because they clearly involve collaboration with other companies, despite the fact that RJR is the only assignee. US 4,870,748 describes an apparatus used to assemble the front end of the Premier article. All of the inventors are employees of Hauni. US 4,903,714 covers the mouthend piece of the Premier article. There are nine co-inventors, only two of which are from RJR. The remaining seven are from Kimberly-Clark.

As before, it is difficult to develop a picture of RJR's strategy from their patents. One possible conclusion is that the number of their patents will begin to decline in the coming years. The number of EPO applications is a good predictor of forthcoming US patents. Although this year RJR had the greatest number of patents in any year for the last four years, they also had the smallest number of EPO applications. Consequently, one would predict that their patent activity might begin to decline. Clearly RJR has a considerable interest in staking as large an area as possible in the "smokeless cigarette" domain. They continue to issue patents dealing with Premier, and they have four additional patents on true non-burning articles - two which use chemical heat sources and two which use electrical heat sources. They are trying to obtain as broad a coverage as possible with regard to use in that the first patent of each pair describes a smoking article, and the second patent describes a drug or flavor delivery device. The remainder of the patents cover such a wide assortment of topics, that no conclusions can be drawn.

The number of publications from RJR in 1989-1990 increased substantially from the previous year. In the period June, 1989, to June, 1990, 30 scientific publications appeared. If RJR's patents did not reveal any clear strategies, their publications do. Twenty-five of the 30 can be organized into five major areas; namely, toxicological papers relating to Premier (6), environmental tobacco smoke (6), analytical chemistry with particular emphasis on Fourier transform infra-red spectrophotometry (8), aerosol research including both aerosol physics and aerosol toxicology (3) and research in the

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Table 10

RJR Tobacco Patents from June, 1989, to June, 1990

Premier Related Patents	Non-Burning Article (Electrical)
US Patents - 5	US Patents - 2
EPO Publications - 1	
Tobacco Flavor Systems	Manufacturing Technology
US Patents - 2	US Patents - 3
EPO Publications - 2	German Patents - 2
QA Methods	Filter Additives
US Patents - 4	US Patents - 2
EPO Publications - 1	
Packaging	Smoking Machine
US Patents - 4	US Patents - 1
Tobacco Reclaiming	Controlled Profile Cigarette
US Patents - 1	US Patents - 1
Premier Manufacturing Equipment	Expanded Tobacco
US Patents - 2	US Patents - 1
Tobacco Extrusion	Reduced Protein Tobacco
US Patents - 1	US Patents - 1
Tobacco Casing	Cigarette Filters
US Patents - 1	US Patents - 2
Non-Burning Article (Chemical)	Tobacco Extenders
US Patents - 2	US Patents - 2
Dense Cigarette	Reduced Sidestream Cigarette
US Patents - 1	US Patents - 1

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chemical senses (2). The remaining five papers each address different areas of research; however, all five of them are either biochemical or toxicological in nature. In the competitive analysis section dealing with RJR in last year's (1990-1994) R&D Strategic Plan, it was mentioned that RJR was collaborating with a large number of outside research groups. This supposition has been amply confirmed by the 29 publications RJR has published in the preceding twelve months. RJR has published jointly with Battelle Research Center, Geneva, Switzerland; Veritas, Burlington, NC; Wake Forest University, Department of Chemistry, Winston-Salem, NC; Wake Forest University, Bowman Gray School of Medicine, Winston-Salem, NC; the University of Arkansas, Medical Sciences Hospital, Little Rock, AR; the University of Bern, Department of Obstetrics and Gynecology, Bern, Switzerland; the University of Colorado, Institute of Behavioral Genetics, Boulder, CO; Hazleton Labs, Kensington, MD; SRI Institute, Menlo Park, CA; Penn State University, Milton S. Hershey Medical Center, Hershey, PA; Battelle Memorial Institute; Pacific Northwest Labs, Richland, WA; the University of North Carolina, Chapel Hill, NC; and Louisiana State University, Biodynamics Institute, Baton Rouge, LA.

RJR R&D Strengths and Weaknesses - Despite cutbacks and morale problems, RJR Tobacco R&D continues to distinguish itself in a number of areas. The two areas of greatest strength continue to be its analytical chemistry group and its toxicology/biochemistry work. RJR R&D appears to have stepped up product development work in 1990; however, the department is clearly having problems in developing new products with a competitive advantage. There is no evidence that any further progress in a low sidestream product has been made. The fact (see above) that RJR is carrying out a tobacco breeding program to produce low-alkaloid tobacco plants would suggest at least some interest in a low nicotine product. However, there is little likelihood that such a product could be developed in less than four or five years due to the poor subjective associated with low alkaloid tobaccos bred in this manner. Product development activities are continuing with distinctive flavors - particularly lemon - using molecular sieves as flavor-release vehicles. Most importantly, of course, considerable resources are being devoted to improving Premier. One weakness mentioned in previous years has been deleted this year. Although RJR Tobacco's work in physics cannot be said to be extremely broad, extensive work in aerosol research and the development of optical processing techniques suggests that it should not be regarded as a weakness. A list of strengths and weaknesses follows.

RJR R&D Strengths

- a. Analytical chemistry - RJR Tobacco R&D continues to demonstrate through publications high quality research in the area of state-of-the-art instrumental

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analysis. Particular emphasis has been placed on Fourier transform infra-red spectrophotometry.

- b. Toxicology/biochemistry - The extensive toxicology group which was put together to evaluate the Premier article is still essentially intact. Work has continued on "products which heat rather than burn tobacco," but has also moved into new areas. One such area is the development of an antibody-based analysis for methoprene.
- c. Electrophysiology - RJR's electrophysiology group continues to both publish and present work involving human response to flavors. Estimates are that their "biobehavioral research" group consists of between ten and 15 individuals.
- d. Environmental Tobacco Smoke - RJR has published a large number of papers in this area covering a number of different aspects of ETS. They would appear to have established a preeminent position in ETS research among domestic tobacco companies.
- e. Optical Inspection Devices - RJR has completed the installation of optical inspection devices in all of their packers. They estimate that these devices will allow them to reduce packaging-related defects by at least 75%. The devices in use were developed jointly by RJR Tobacco R&D and Videk, a subsidiary of Eastman Kodak. In addition RJR Tobacco R&D has a large group devoted to the development of new optical processing techniques.
- f. Process Development - Recent patents indicate that RJR is continuing to pursue novel process development techniques. As was mentioned above, the patents relating to the deposition of a flavorant in the center of a cigarette at the maker may be of considerable utility for specialized products.
- g. Extensive outside industrial contacts - RJR has apparently cut back on its collaborative research with universities. They continue to work closely, however, with a large number of suppliers including suppliers who have not traditionally been involved in the tobacco industry. Examples include collaboration with ImmunoSystems Incorporated to develop an antibody-based analysis for methoprene, Videk for the joint development of optical inspection systems, Union Carbide for the development of zeolites for flavor-release, and Integrated Separation Systems involving new techniques for two dimensional gel electrophoresis.

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RJR R&D Weaknesses

- a. Organic and inorganic chemistry - RJR Tobacco R&D continues to depend primarily on outside expertise for basic organic and inorganic chemical research.
- b. Materials Science - There is still no evidence that any research in this area is being carried out by RJR Tobacco. An RJR scientist attended an American Ceramic Society meeting last year. RJR appeared to be interested in novel materials for use in filters. However, there does not appear to be any individual on their staff with the requisite background to carry out this research, and no patents or publications have appeared to indicate that such research is ongoing.
- c. Paper technology - RJR continues to be completely dependent on its paper suppliers for the development of new cigarette papers.
- d. Natural product chemistry - For the first time in three years there was one publication dealing with natural product chemistry. There still appears to be a significant lack of activity in this important area.

BROWN AND WILLIAMSON

B&W Highlights - After considerable time and legal maneuvering Sir James Goldsmith abandoned all attempts to take over BAT Tobacco. Consequently, unlike RJR, B&W will remain a publicly owned company. BAT has done some restructuring during the previous year in order to make it more difficult for a hostile takeover to be pursued. They have defined their core businesses as tobacco and insurance. Since February, 1990, they have sold off eight businesses, including Saks Fifth Avenue and Marshall Field divisions, which no longer fit in with their core businesses. There has been some discussion that BAT will combine its laboratory in Hamburg with its Southampton facility; however, no action has been taken yet.

B&W Domestic New Product Introductions - Brown and Williamson has introduced no new product nationally and has test marketed only one new product domestically in 1990. Kool DeLuxe Lights 85 and 100 (box) and Kool DeLuxe Ultra Lights 85 and 100 (box) were test marketed in Hawaii in June, 1990. The Lights cigarettes deliver 10 mg tar, 0.9 mg nicotine and 0.5 mg menthol; the Ultra Lights cigarettes deliver 6 mg tar, 0.6 mg nicotine and 0.35 mg smoke menthol. These cigarettes have a 27 mm CA filter.

B&W R&D Organization - We have continued to expand our organizational chart for the B&W R&D Center. We now have identified 82 staff members by name and technical area. This represents about 1/4 of the total R&D staff and about 1/2 of the

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professional staff. The R&D Center is headed by J. S. Wigand, Vice President, Research and Development. Three Directors report to him - Andrew McMurtrie, Director of Product Development; Lance Reynolds, Director of Research; and the Director of Technical Services. Product Development is divided into six divisions, blend development, cigarette design, development center, filter development, international product development, and packaging; Research is divided into three divisions, analytical methods, microbiology, and new technologies; and Technical Services is divided into five divisions, cigarette intelligence, product evaluation, statistics, technical information, and technical project planning. The B&W organizational chart can be found in Appendix H.

BAT appears to be increasing its commitment to research both in the US and the UK. They are continuing to add staff to their Louisville Research Center. An advertisement appeared in Food Technology in March, 1990, for a flavor chemist. Southampton, which had significantly cut back its staff working in basic research, appears to now be reversing this trend. The laboratory was reorganized in April, 1990. A Fundamental Research Center has been established with Dr. R. R. Baker as its head. A BAT Technical Center was also established.

B&W Patents and Publications - Brown and Williamson increased its patenting activity slightly over the previous year, although the total number of BAT patents and patent applications declined. B&W received eleven US patents and one Canadian patent. BAT, UK had five issued US patents, two EPO applications and two UK applications. Lastly, BAT Cigaretten-fabriken GmbH had six issued US patents, five issued German patents, two EPO applications and one UK application. The totals are 22 issued US patents, 5 issued German patents, one issued Canadian patent, 4 EPO publications and 3 UK applications. All of the patents are broken down into the specific areas covered in Table 11.

A number of these patents deserve some discussion. US 4,911,184 from BAT, UK, covers low sidestream smoking articles. All of the claims (23) involve double-wrapped articles similar to Virginia Slims Superslims. However, the UK patent application on which this patent was based had no claims involving double-wrapped cigarettes. Apparently, before the US patent was allowed, B&W picked up some of our Superslims which had been submitted for outside panel testing. Since the teachings of the patent had two sentences mentioning double wrapped cigarettes, all of the claims were changed to cover that subject matter. Consequently, B&W has taken advantage of an earlier filing date than the PM patent application on Superslims to claim infringement.

US 4,898,191; 4,913,169; 4,917,121; 4,924,886; and EP 354,661(A) claim Premier type articles. None of these patents or applications contains any documentation suggesting

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Table 11

BAT Patents from June, 1989, to June, 1990

Packaging	Smoking Articles
US Patents - 3	US Patents - 2
German Patents - 1	German Patents - 1
UK Applications - 2	UK Applications - 1
Premier Type Articles	Low Sidestream Cigarettes
US Patents - 4	US Patents - 2
EPO Applications - 1	EPO Applications - 1
Tobacco Expansion	Reconstituted Tobacco
US Patents - 2	US Patents - 1
Canadian Patents - 1	EPO Applications - 1
Manufacturing Equipment	QA Inspection Devices
US Patents - 2	US Patents - 2
German Patents - 3	
Non-Burning Article	Selective Filtration
US Patents - 1	EPO Applications - 1
Grooved Filters	
US Patents - 2	

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that the articles described have actually been made. In other words they are "concept patents." It is quite likely, based on our own experience, that the articles described would be quite difficult to make, and would probably not function as claimed without the development of new technology. Nevertheless, these patents establish a proprietary position for B&W in this area. One interesting feature of some of these patents is that B&W has addressed one of the customer complaints regarding Premier; that is, the failure of the Premier article to burn down like a cigarette. They have proposed a number of models where the heat source is an outer tobacco core which surrounds an air impermeable, temperature frangible wrapper which, in turn, surrounds a center core containing an aerosol generating material. The interface between the front end and the mouth end is designed so that the smoker cannot inhale any smoke from the burning tobacco. As the tobacco burns statically, it produces an ash which, in combination with the frangible wrapper and the spent aerosol generating material, can be flicked off the article.

European Patent Office Publication 346,648(A) describes a process for impregnating cigarette filter tow with di- or polycarboxylic acids or their anhydrides in order to increase filtration efficiency for basic smoke components such as nicotine. The only novel portion of this application is the use of anhydrides which are then hydrolyzed to the acids by storing the filters in a humid atmosphere. The use of acids on filters is an area which we are looking at rather carefully at this time.

Based on the patents BAT has published during the last year a number of strategies are evident. BAT Cigaretten-fabriken GmbH continues to produce patents in the areas of manufacturing technology and QA inspection devices. As was pointed out last year, BAT appears to be attempting to improve quality and to decrease cost through greater manufacturing efficiency. Clearly BAT has devoted considerable research resources to the development of articles which could compete with Premier. It does not appear that much in the way of product development resources have been devoted to this program, however. As pointed out above, however, they have established a proprietary position. Low sidestream products continue to be pursued, although the work that has been done is of little consequence. Lastly, BAT remains quite active in the area of packaging patents.

Once again, except for a few TCRC presentations, B&W had no publications.

B&W R&D Strengths and Weaknesses - Brown and Williamson's R&D Department is approximately half the size of the Philip Morris USA Research Center. As such they are less able to commit resources to the development of radical new products, such as ART or Premier, than is either Philip Morris or RJR. Although the combined total tobacco related R&D resources of BAT may be equivalent to PM USA, there is probably

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considerable overlap in areas of expertise which prevents full utilization of the resources. BAT tends to have considerable strength in the process development and engineering areas including the development of improved manufacturing equipment, QA inspection devices, and process modifications. Although they have been increasing their commitment to basic research, they seem to be weak in the application of this basic research to new product development. For example, they have done considerable work with low sidestream wrappers without really developing any new technology. They are opportunistic, however. They can continue to compete with companies which are larger than they are by rapidly analyzing new technologies from their competitors and changing them sufficiently to give them a proprietary position. As a consequence, to ensure the best possible competitive position with regard to B&W, it is necessary for PM USA to establish as strong a patent position as possible.

JAPAN TOBACCO INTERNATIONAL

JTI New Product Introductions - Beside King Size (soft pack) cigarettes were introduced to the Japanese market in October, 1989. This product delivers 10 mg tar and 1.0 mg nicotine and has a dual carbon in CA/CA filter.

Peace International 95 (box) cigarettes were introduced to the Japanese market in October, 1989. These cigarettes deliver 14 mg tar and 1.3 mg nicotine. Peace International has a single 25 mm CA filter and is packaged in a princess box.

With Class King Size (box) were introduced in December, 1989. This brand delivers 10 mg tar and 0.8 mg nicotine. The cigarette has a dual carbon in CA/CA filter.

Keith Slim Long Size (box) and Keith Mild King Size (box) little cigars were introduced in March, 1990. These little cigars are wrapped in a tobacco wrapper, similar in appearance to a reconstituted sheet. The wrapper contains small pieces of tobacco and measures 50-60 μ in thickness compared to Philip Morris' RL which is 150-160 μ thick. The wrapper contains both propylene glycol and glycerine as humectants, and has a Coresta porosity of about 2. These products deliver 20 mg tar and 1.5 mg nicotine with a puff count of about 14. Keith Slim Long Size has a 23 mm circumference and a single CA filter, while Keith Mild King Size has a 25 mm circumference and a dual carbon in CA/CA filter. Both products have filter ventilation. Keith little cigars were measured to have low visible sidestream which is a consequence of its high puff count and low wrapper porosity.

In April, 1990, Japan Tobacco introduced Select Special Lights King Size (soft pack) cigarettes. This brand delivers 10 mg tar and 0.9 mg nicotine. Select has a dual carbon in CA/CA filter.

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Seven Stars Custom Lights King Size (box) cigarettes were introduced to the Japanese market in May, 1990. This brand has a dual carbon in CA/CA filter and delivers 10 mg tar and 0.9 mg nicotine.

JTI R&D Organization - Last year it was pointed out that Japan Tobacco has three R&D laboratories. Further research has shown that the number is 11. These laboratories are 1) Applied Plant Research Laboratory, 2) Tobacco Research Laboratory, 3) Tobacco Central Research Laboratory, 4) Pharmaceutical Research Laboratory, 5) Toxicological Research Laboratory, 6) Food Research Laboratory, 7) Life Sciences Laboratory, 8) Sea Water Combined Research Center, 9) Engineering Research Laboratory, 10) Plant Breeding and Research Laboratory, and 11) Product Development Center. Only the Tobacco Research Laboratory, the Tobacco Central Research Laboratory, the Process Development Research Laboratory and the Product Development Center are involved in cigarette related research and development. Consequently, it is difficult to compare our information on Japan Tobacco's R&D's budget, quoted at \$400 million, to PM USA's R&D budget.

During the last twelve months publications have originated from eight of these eleven R&D laboratories. The number of publications from each lab are: Applied Plant Research Laboratory, 3; Tobacco Research Laboratory, 7; Tobacco Central Research Laboratory, 1; Pharmaceutical Research Laboratory, 3; Toxicological Research Laboratory, 3; Life Sciences Laboratory, 22; Engineering Research Laboratory, 1; and Plant Breeding and Genetics Laboratory, 3.

It would be extremely difficult to construct an organization chart, as has been done for RJR and B&W, for any of the Japan Tobacco R&D laboratories for a number of reasons. Nor would it be particularly helpful to have such an organization chart. We have, however, determined the location and the head of each of their R&D labs, and this information is given in Table 12. Additional information on JTI, including the 1989 Annual Report and brochures from their key sciences and Tobacco Sciences Research Laboratories can be found in Appendix I.

JTI Patents and Publications - During the twelve month period between June, 1989, and June, 1990, Japan Tobacco had 22 issued US patents, 4 European Patent Office Publications, and 9 issued Japanese patents. The majority of these patents (60%) fit into two categories; namely, manufacturing equipment (11 US patents, 2 EPO publications, and 1 Japanese patent) and catalysts for carrying out organic reactions (7 US patents). The total breakdown of all 35 patents by subject matter is given in Table 13. One of the catalyst patents (US 4,845,065) is of special interest since it describes a material for the oxidation of carbon monoxide. The use for this catalyst would appear to be to reduce carbon monoxide in ETS as opposed to oxidation of carbon monoxide in mainstream

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Table 12
Japan Tobacco R&D Laboratories

Laboratory Name	Location	Laboratory Head
Applied Plant Research	Tochigi	Koye
Tobacco Research Laboratory	Tochigi	Nishinaka
Tobacco Central Research Laboratory	Yokohama	Maeda
Pharmaceutical Research Laboratory	Yokohama	Muriyama
Toxicological Research Laboratory	Hatano	Kubo
Food Research Laboratory	Yokohama	Kanaho
Life Sciences Laboratory	Yokohama	Kato
Sea Water Combined Research Center	Odahara	Mizusaki
Engineering Research Laboratory	Hiratsuka	Okada
Plant Breeding and Genetics Laboratory	Toyada	Tachimichi
Product Development Center	Tokyo	Saito

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Table 13

Japan Tobacco Patents from June, 1989 to June, 1990

Manufacturing Equipment

US Patents - 11
EPO Publications - 2
Japan Patents - 1

Catalysts

US Patents - 7

QA Inspection Devices

EPO Publications - 1
Japan Patents - 3

Agricultural Equipment

US Patents - 1
Japan Patents - 1

Filters

US Patents - 2

Biotechnology

US Patents - 1

Tobacco Expansion

EPO Publications - 1

Tobacco Extract Deodorant

Japan Patents - 1

Tobacco Mothproofing Agent

Japan Patents - 1

Tobacco Processing

Japan Patents - 1

Aroma Inhalation Article

Japan Patents - 1

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smoke. The patent states that the application is in removal of carbon monoxide from air, and the catalyst utilizes palladium and copper salts as the main ingredients. Two Japanese patents (Japan 01-151,460 and 01-151,505) exemplify one of Japan Tobacco's strategies; that is, the application of tobacco materials to other product areas. The first of these patents describes a tobacco extract deodorant, while the second covers tobacco extract as a mothproofing agent. The last patent of interest (Japan 01-191,674) teaches an aroma inhalation article which uses a chemical heat source to volatilize the aroma. This invention is quite similar to the packages now available in Japan which can provide heated Sake.

JTI continues to be involved in expanded tobacco. PM is currently in litigation with them regarding their alleged infringement of our DIET patents. The most likely scenario is that their activity will not have significant impact on our ET position. On the other hand, our activity will have little impact on their position.

As was the case in the previous twelve month period, Japan Tobacco's publications span a large number of basic research areas with primary concentration in "biotechnology." In the twelve month period between June, 1989, and June, 1990, 43 publications originated from eight of the eleven Japan Tobacco R&D laboratories. These publications can be categorized as: biochemistry, 10; toxicology, 8; organic chemistry, 7; catalysts, 6; tobacco chemistry, 5; entomology, 3; biophysics, 2; natural products chemistry, 1; and materials science, 1. The subject matter of these publications clearly are indicative of Japan Tobacco's long term strategy. They are doing considerable work in the area of developing improved plants (resistance to herbicides, insect resistance, etc.), particularly tobacco and rice. There are a significant number of publications describing toxicological studies relating to smoking and health issues. Considerable resources have been devoted to organic synthesis pertaining to two areas - new flavorant compounds and nucleosides to be used in Japan Tobacco's biochemical research. Of particular interest is extensive work with metal oxide catalyst systems which are primarily being used for the reduction or oxidation of organic compounds. It is not obvious as to where this work might be applied.

Japan Tobacco scientists do considerable collaborative work with scientists in university, government, and industrial laboratories. A partial list of collaborators includes Kitasata University, School of Hygienic Science; Kyoto University, Food Science Research Institute; Kyushu University, Institute of Genetic Resources and Plant Breeding Laboratory; Kinki University, Plant Nutrition Laboratory; Ministry of Agriculture, Forestry and Fisheries; Kyoto University, Wood Research Institute; Yuki Gosei Kogyo Ltd., Tokyo Research Laboratory; Mitsubishi Kasei Co., Toxicology Laboratory; National Institute of Hygienic Science, Biological Safety Laboratory; Itoham Food Inc., Toxicology Research Institute; Yamanouchi Pharmaceutical Co. Ltd., Product

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Development Laboratory; Institute of Environmental Toxicology; Daiichi Seiyaku Co. Ltd., Research Institute; Institute of Physical and Chemical Research; University of Tokyo, Department of Agricultural Chemistry; Food and Drug Safety Center, Hatano Research Institute; and Nippon Steel Corp. Ltd., R&D Laboratory.

JTI R&D Strengths and Weaknesses - Japan Tobacco appears to have established a course which is quite different from its worldwide competitors. Rather than diversifying through acquisition, they appear to be establishing new businesses through development of new technology and application of this technology to new areas. Although they continue to introduce new brands into the Japanese market (see above), they continue to lose market share to American companies, particularly Philip Morris, and almost appear to concede the Japanese market to the American companies in the long term. On the other hand they are aggressively pursuing the export of their products. The company announced in May, 1990, that their exports grew to 6.307 billion units, a 48% increase from 1988. Southeast Asian nations and territories, including Hong Kong, China and Singapore, accounted for 70% of the export volume. The Middle East followed with 20%. Japan Tobacco is also marketing their Mild Seven brand to Americans of Asian extraction. Although no figures are available, they appear to be having some success with this strategy on both the west and east coasts.

Japan Tobacco is also aggressively pursuing joint ventures with companies both in Japan and abroad to market their new products in the "biotechnology" area. The company recently formed an R&D partnership with Mycogen, an American biotechnology company, to jointly develop and commercialize bioherbicides worldwide. Japan Tobacco will receive 75% of the profits from sales in Japan, and 25% of the profits from sales in the United States. The two companies will share profits equally from sales in other parts of the world. Japan Tobacco has taken about a 3% equity position in Mycogen, and is funding research at the company at a rate of \$7 million over three years. Another recent announcement disclosed that Japan Tobacco has joined with three other major Japanese companies, Komatsu Ltd., Toshiba Corp. and Kajima Corp., to develop technology for automatic grafting of highly disease-resistant cabbages to boost productivity.

Japan Tobacco has extensive R&D facilities which span a large number of scientific disciplines. Their basic research is outstanding. If they appear to be less successful in the application of this basic research to new cigarette products, it is either because cigarettes are now of lower priority in their overall plan or possibly because their best people are working in other areas.

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OTHER TOBACCO COMPANIES

New Product Introductions-USA - The remaining three domestic tobacco companies have introduced new products either nationally or in test market. Lorillard has at last test marketed its first generic products. Harley Davidson 85 and Harley Davidson Lights 85 are in test market in Arkansas, while Heritage Lights 85 and 100 cigarettes are being test marketed in Louisville, Kentucky, Portland, Oregon, and Maine. The latter product has a \$4.00 off coupon attached to the carton.

The Liggett Group has established a third price tier. Pyramid Full Flavor 85 and 100 (regular and menthol) were introduced nationally. This subgenerically priced product utilizes wood pulp cigarette paper.

Response to the introduction of Pyramid was swift at both Philip Morris and American Tobacco. American introduced Montclair Lights 100 (regular and menthol), Montclair Full Flavor 100, and Montclair Ultra Lights 100 nationally at subgeneric prices to compete against both Pyramid and Bristol. As of the third quarter 1990, Pyramid had a 13% market share, while Montclair had a 0.7% market share during the same period. American has introduced two branded generic brands nationally; namely, American Lights 100 cigarettes and Malibu Ultra Lights 100 cigarettes. Lastly, American is test marketing Misty Lights 100 box (regular and menthol) cigarettes in both California and Louisiana. Interestingly, the cigarette will be priced as a full margin product in California, and as a branded generic in Louisiana.

New Product Introductions-Japan - Brown and Williamson, RJR, and American Tobacco have all introduced new products in Japan during the past twelve months. Brown and Williamson began exporting Barclay King Size (soft pack and box) cigarettes in December. This product has a dual carbon in CA/CA filter. The outer filter is typical of the domestic Barclay. These cigarettes were smoked using both the standard and modified cigarette holders. As expected, the smoke deliveries were higher when smoked with the modified holder.

RJR began exporting Vantage King Size (box) to Japan in January, 1990. This brand is similar in all characteristics to Vantage King Size (soft pack) which was introduced to Japan in March, 1989.

American Super Lights 100 (soft pack) cigarettes became available to Japanese consumers in November. This brand is exported to Japan by the American Tobacco Company. These cigarettes have a dual carbon in CA/CA and deliver 9 mg tar and 0.8 mg nicotine.

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Patents and Publications - The patents for the other tobacco companies are covered in the next section on Emerging Competitor Technology. American Tobacco and Liggett & Myers had no published papers from 1989 to August, 1990. Lorillard had two publications in that time period, one related to chemical synthesis of alkyl macroisocyclic ethers and the other related to ignition propensity and a cigarette ignitability index.

Emerging Competitor Technology

Earlier in this section, an in-depth review of patented technology developed by major tobacco companies including RJR, B&W/BAT and JTI was provided. Patents or published applications assigned to smaller cigarette manufacturers or other companies of interest were also reviewed to determine potential new technology trends that might be of interest. The table below lists US, European Patent Office (EPO) applications and British applications/patents for the past year for the companies noted.

<u>Company</u>	<u>US Patents</u>	<u>EPO Appl.</u>	<u>UK Appl.</u>	<u>German</u>	<u>Canadian</u>	<u>Japanese</u>
PM*	23	16	**	**	3	16
RJR	40	4	0/3	2	--	--
B&W/BAT	1/11	0/4	-	0/5	1/0	--
JTI	22	4	--	--	--	9
Gallaher	2	--	--			
Imperial	2	1	2			
Liggett	--	--	--			
Loew's Corp.	--	--	--			
Reemtsma	--	2	2			
Rothmans	3	3	--			

* PM USA and PM International

**UK and German designated through EPO

R&D subject matter experts were identified and requested to review all competitor patents and/or published applications. Documents of interest were selected for further, in-depth analysis. A brief synopsis of those selected, by technology category, is listed below.

Humidity Control in Cigarette Packages

Both Brown and Williamson and Kimberly-Clark filed US applications pertaining to humidity control in packaging in 1988, and corresponding applications have been

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published in the U.K. (2,222,816) and EPO (348,840), respectively. Both teach the use of saturated salt solutions to maintain the desired level of moisture equilibrium within the pack.

Tobacco Processing

A. Sheet Technology

BAT, in EPO published application 345,477, teaches a process for extrusion of round tobacco strands which are subsequently compressed to a narrow "ribbon" between 10 and 100 mm wide. Thereafter, the "ribbon" may be shredded for incorporation in a tobacco blend.

B. Expanded Tobacco

Both BAT (US Patent 4,844,101) and JTI (EPO 328,676) disclose improved apparatus for use in CO₂-type expansion processes. The apparatus improvement claimed by BAT comprises a cellular wheel tobacco material feeder and an expansion chamber integrated within the cellular wheel feeder. Steam consumption is said to be substantially reduced. The apparatus disclosed by JTI provides for a continuous expansion process using CO₂, whereby the material to be expanded can be continuously supplied to the impregnation vessel or discharged from it while the pressure within the vessel remains unchanged.

RJR was granted US Patent 4,922,932 for an improved expansion apparatus which minimizes release of impregnating or treatment medium into the atmosphere.

C. Flavor Technology

US Patent 4,898,188 granted to RJR discloses the extraction of tobacco flavor components via supercritical fluids from one type of tobacco and reapplication to another type while in the supercritical or subcritical state.

RJR, in US Patent 4,887,619, discloses an improved casing cylinder utilizing steam-fed nozzles for directing pressurized steam against the inner wall surface to prevent the accumulation of tobacco deposits on the cylinder walls.

New Products

A. Combustible Smoking Products

US Patent 4,893,638 assigned to B&W discloses a cigarette, 10-19 mm in circumference and containing ground tobacco having a particle size of about 0.5 mm to 3.00 mm. The exposed end of the cigarette is coated with a polymeric material to prevent the fine particles from falling out.

Imperial Tobacco Limited was granted US Patent 4,881,555 which discloses a cigarette having a plug between the filter and tobacco rod. The plug is a heat sensitive aroma-release element which releases a pleasing aroma to the environment as the burning coal comes into contact with it. Apparently, the objective is not to flavor mainstream smoke, but to improve ashtray odor and possibly to avoid the odor of extinguished cigarettes.

BAT was granted US Patent 4,838,286 which discloses a conventional tobacco rod having a bore or passageway approximately three-fourths the length of the rod and in direct "gas flow communication" with a plug-space plug filter. The filter space is filled with menthol containing granules or other vapor-release materials. The article, on smoking, delivers substantially higher levels of menthol and a cooler smoke.

RJR was granted US Patent 4,920,990 which appears to be a combustible rod containing 40-85% tobacco and 15-60% of another smokable material comprised of inorganic materials, carbonaceous matter and binding agents. The nicotine content is greater than 2% based on dry weight of smokable material.

Brown & Williamson was granted US Patent 4,917,121 and a similar application, UK 2,224,921 was published. The UK application discloses a smoking article having a tobacco column and a rigid, gas-impermeable tube running the length of the column and in direct gas flow with the mouthpiece. The tube contains flavor release and aerosol generating material which is released by the heat of the burning tobacco. Tobacco smoke is blocked from entering the mouthpiece. The US Patent is identical except that the filter end is equipped with a cooling chamber, a tobacco plug and an additional cooling chamber. Aerosol and flavors pass through and pick up tobacco flavor from the plug on "smoking" the article.

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B. Non-Burning Articles

US Patent 4,913,168 assigned to RJR discloses the reaction of water with certain chemicals (metal oxide or an anhydrous metal sulfate) to generate heat and volatilize flavors in a non-burning article. Temperatures ranging between 70° and 200° C for 4-8 minutes are disclosed as a result of the chemical reaction in which the noted constituents are mixed.

Advanced Tobacco Products was granted US Patent 4,917,120 for a non-combustible substitute containing nicotine impact modifying agents which modulate the nicotine vapor by either quantity or physiological impact or both. Flavorless esters are claimed to be the preferred material for use.

US Patent 4,922,901 and EPO application 358,002 assigned to RJR disclose articles that utilize electrical energy to provide an aerosol. The EPO application discloses a reusable control unit which includes a puff-activated current switch, a time-based current regulator to control the heating element temperature and a battery. The 4,922,901 patent refers to a drug delivery device which employs an electrical power source. Both are essentially identical devices.

B&W was also granted US Patent 4,913,169 which discloses an article similar to others previously described with the exception that a heat conducting strip runs concentrically through a center tube and apparently enhances aerosol generation.

C. Nicotine Release Articles

AB Leo was granted US Patent 4,907,606 for an article which contains tobacco, sodium carbonate and flavoring agents. Tobacco is heated below the combustion temperature, but at a sufficient temperature to liberate nicotine when air is drawn through the article.

Schering Pharmaceutical has recently received a patent on a nicotine-release dermal patch which releases nicotine over a prolonged period of time.

Low Sidestream Products

In German Patentschrift (issued patent) 3,836,210, BAT discloses a coaxial cigarette which, on burning, leaves essentially no residual ash. The cigarette construction involves an inner rod or core surrounded by a wrapper and an outer core of tobacco. The inner wrapper may be paper or reconstituted tobacco with an air permeability less than 3 ISO units. The permeability of the outer wrapper is between 15-40 ISO units.

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The rod has a low-burn rate, reduced TPM, CO and nicotine per puff, and sidestream between puffs is reduced.

EPO applications 325,920 and 325,921 assigned to Reemtsma disclose a self-extinguishing cigarette and a low sidestream product respectively. Self-extinguishing features are achieved by the use of paper having along its length alternate zones of higher and lower permeability, obtained by compression or batonning of the paper in annular zones during its manufacture. The paper used to reduce sidestream is "batonned" by use of an embossing calendar mechanism. The compressed zones of the paper are ring-shaped, each being 0.1 - 0.8 mm long and the interval between zones is 0.1 - 5.0 mm.

US Patent 4,911,184 assigned to B&W describes a product less than 20 mm in circumference and wrapped in two discrete wrappers pretreated with sidestream reducing compounds. Compounds disclosed include the hydroxides of alumina, calcium, lithium and magnesium, or magnesium oxide. Alumina and Attapulgite clay are also disclosed. Sidestream reductions up to 30% are said to be achieved on smoking the double-wrapped cigarette.

RJR in US Patent 4,924,888 discloses a cigarette wrapped in paper containing inorganic oxide and/or hydroxide, and having an inherent permeability of less than about 30 CORESTA units and a net permeability of between 80 and 140 CORESTA units. Tobacco density in the rod is between 100- 200 mg/cm³.

EPO application 357,359 assigned to BAT describes a reduced sidestream cigarette wrapper containing between 7 and 40% by weight of calcium sulfate dihydrate or calcium tartrate as a filler in the wrapper. The filler may also contain calcium carbonate, magnesium oxide or hydroxide, alumina or Attapulgite clay.

Flavors

US Patent 4,836,224 assigned to RJR discloses cigarettes having high nicotine content (i.e., greater than 2%) tobacco filler; the product is enhanced by the addition of organic acids, preferably levulinic acid in dissociated and/or nondissociated form. The additive is applied to the filler, filter, or both at levels greater than 1%, based on the dry weight of the filler.

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Filters

A. Filter Additives

EPO application 346,648 assigned to BAT describes the use of carboxylic acid additives to cigarette filter tow. Alternatively, the anhydride of the acid may be used. Filtration efficiency for basic smoke constituents such as nicotine is said to be increased.

In US Patent 4,861,324 assigned to JTI an improved apparatus and process are disclosed for depositing granular materials onto filter tow.

In US Patent 4,865,056, also assigned to JTI, there is disclosed an easily breakable capsule positioned near the filter end of the cigarette. The capsule contains water; on lighting, the smoker breaks the capsule to wet the filter, thereby providing a "soft" smoke with reduced smoke constituent delivery.

B. Filter Design

BAT received US Patent 4,874,004 which describes the coaxial filter construction for its previously described coaxial cigarette. The filter has up to four separate wrappers to accommodate its inner and outer cores.

UK application 2,217,971 assigned to Imperial Tobacco discloses a controlled profile filter having a conical smoke impermeable chamber extending axially into the plug. Slits in the chamber become occluded on smoking causing the path length of smoke through the filter to increase thereby causing a relatively constant TPM/puff throughout the smoking of the cigarette.

In EPO application 364,256 Rothmans describes a filter having a more uniform delivery profile. The filter comprises a cylindrical hollow tube with a disc with one or more openings. The disc, consisting of micro-fine fibers, is sealed to the inner surface of the tube.

UK application 2,212,707 assigned to BAT discloses cigarettes of conventional or smaller circumference having filters of differing circumference. A number of different construction drawings are provided to demonstrate the invention.

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Make/Pack

US Patent 4,899,765 assigned to RJR discloses high-speed makers having a tongue which is equipped such that water is continuously fed to the tobacco filler passing through the garniture region of the maker. Cigarettes of controlled density and firmness and having low amounts of hard spots, loose ends, etc. can be manufactured. The improvement is said to be especially beneficial for blends containing relatively high levels of expanded tobacco.

German Offenlegungsschrift (published application) 3,844,620 assigned to Reynolds discloses application of flavorants at the maker at a point where the rod is half formed. The risk of spotting of the cigarette paper is said to be reduced.

Rothmans, in US Patent 4,896,681, discloses a method and apparatus for forming a rod containing two different blends of tobacco. Discrete "bunches" of one type tobacco are formed, and spaces between the "bunches" are filled with tobacco of a different blend by a variety of procedures. The process is said to produce rods with more uniform smoking characteristics.

BAT, in US Patent 4,865,051, discloses an apparatus for the continuous determination of two physical properties during the production of tobacco rods. The apparatus is designed to measure both hardness and RTD. Production problems can be identified immediately and corrected by means of an appropriate control.

Summary

During the plan year, tobacco-related patents and patents for non-tobacco articles and devices will be closely monitored and reviewed. Publications such as the weekly edition of the United States Patent and Trademark Office Gazette and the Tobacco Patents Bulletin (EPO and other European patents/applications) are reviewed on a continual basis, and selected abstracts of interest are published in the R&D Patent Update Bulletin. Careful analysis of documents of interest will be obtained and provided to management by the Patent Review Committee in conjunction with the Strategic Planning Committee.

Supplier Analysis

Flavor Suppliers - In 1985, R&D established agreements with flavor vendors to permit our receiving qualitative composite disclosures from the vendors for our compliance with Section 7 of the Labeling Act. In 1986 those agreements were amended to provide for quantitative data on selected ingredients as necessary. In December, 1986, at the Planning Meeting, it was decided that R&D will know and be responsible for each and

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every Philip Morris ingredient. Therefore, a program was begun to establish exact chemical specifications for each flavor. To facilitate this program, agreements were established with each vendor to provide for semi-quantitative disclosure of ingredients, by flavor, utilizing ranges <0.1%, 0.1-1.0%, 1.0-10.0%, and >10%. The specification program is in progress, and also includes the German Certification program. This effort ensures that all of the ingredients in the flavors and casing shipped are acceptable under German law. The net result is that our flavors and casings meet or exceed the strictest regulations in the world.

Filter Tow Suppliers - Celanese is continuing to work with Kimberly-Clark and Dexter to develop a CA Web product. As of November, 1990, an acceptable product has not been made. The subjectives are not exactly like CA, and the variability of resulting filter rods is high. Dexter is pursuing a different formulation. The current pricing and availability situation is very poor. Efforts on behalf of Celanese will probably diminish because of the cost of future mill runs. PM will continue to evaluate materials as they become available.

A menthol migration (stability) study was completed by Eastman. The results indicated that factors such as triacetin in the CA dope and filter preheat treatment do not improve menthol stability over triacetin applied conventionally. Eastman is continuing to pursue high efficiency tows and has agreed to provide us with 1/8" CA staple (to support PM web development efforts). Thus far, 300 lbs. have been supplied; however, they are seeking a long-term commitment from PM to improve their process and the product. Celanese was not willing to work with PM in this area. An Eastman patent involving spiral wound CA tow bands to form a cigarette filter was recently brought to our attention. Additional information is being sought. Currently, there are no PM programs ongoing at Rhodia. However, we are evaluating samples of supercrimp tow from them. Recently, a preliminary evaluation of Rhodia 2.1 dpf supercrimp tow was completed, and a weight savings over two control tow items, an increase in efficiency and more variability in RTD and weight was seen. A lower dpf supercrimp tow item (1.5) will be requested for evaluation.

A confidentiality agreement is being pursued with Courtaulds for work in the area of cellulose modification.

Packaging - Purchasing Technical Services (PTS) has instituted a vendor/supplier specification and review program to ensure that all inks, adhesives, coatings, and paper systems used in Philip Morris packaging, tipping and printed components comply with PM requirements for safety, subjective attributes and performance. These specifications are used for all domestic and some international printers. The requirements are based on

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manufacturing safety and performance, subjective taste and odor, and environmental (air, water, and solid waste disposal) issues.

Formula breakdowns for ink systems, coatings, board material, etc. are submitted to PTS by our vendors. PTS maintains a database on these materials and assigns test numbers. Actual physical samples are also received, when vendors cannot or do not wish to disclose formulations. The formulations and samples are sent to R&D Project 5001, Packaging Studies, which in-turn sends them to Analytical Research. The formulations are reviewed, and recommendations are made as to acceptability prior to use by our printers. Samples are submitted to the Materials Evaluation laboratory (or other appropriate analytical lab) for analysis. Recommendations for these samples are given based on the analytical results. The recommendations are made following PM guidelines which involve the toxicology of compounds, potential disposal problems, and employee safety. The results are reported back to Packaging Studies, who reports them back to PTS. If a product formulation has been approved by Analytical Research, it must still pass subjective testing (coordinated by Packaging Studies) and finally machinability before it is qualified for use. In 1989, Analytical Research received over 100 formulations and samples for review; to date this year over 70 samples have been received. PTS received over 750 formulations for consideration in 1989.

Another aspect of packaging which is monitored is residual solvents which remain after printing. PTS, in conjunction with Packaging Studies, has developed a list of solvents which cannot be used and threshold limits for others. The solvents are monitored on finished packaging using headspace GC. Incoming QA monitors all new brands and selected production brands. Project 6505, Special Investigations, analyzes new formulations before they reach production, and also provides identification of unknowns in new formulations and those found in production runs.

The most recent testing of packaging material has been for the determination of four heavy metals that were designated by the Conference of Northeastern Governors legislation. A procedure was developed by Project 1759 which uses Energy Dispersive X-ray Fluorescence (EDXRF) to screen packaging for the selected elements. This is not a quantitative procedure, but one which can establish that the levels in the material are below the 600 ppm stated by the legislation. Investigations are continuing to develop a suitable method for accurate quantitation. For the EDXRF method, samples are taken from the component (i.e. a label) such that a sample representing each ink color used is analyzed. For example, samples for a Marlboro label would consist of a red, black, white and the crest areas. Screening of current production will be done by brand family. To date only Marlboro "Red Roof" components have been completed. New brands will be screened as they are received. The samples are collected by Incoming QA.

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Paper Suppliers - During 1990 we have continued working with Kimberly-Clark (KC) to develop cigarette papers for reduced sidestream cigarette designs. Much of the work has involved a high basis weight (63 g/m^2) calcium carbonate paper. Paper properties such as calcium carbonate level, type and concentration of sizing agent, and permeability have been explored on base sheets made in KC's mill and sized either on their laboratory coater or on ours. We have also received variations of the Superslims outer wrap paper (45 g/m^2) from KC for evaluation as a single wrap on low sidestream cigarette models. Flavor-release coatings have been coated on both conventional wrappers and on the low sidestream wrappers listed above for evaluation on cigarette models.

Low sidestream wrapper development work has been conducted with Ecusta in search of a magnesium filler that can yield low sidestream delivery with acceptable taste characteristics. Progress has been made toward identifying processing requirements for a mined magnesium carbonate material for a mill trial at Ecusta. Ecusta has continued to supply samples of magnesium hydroxide papers for our evaluation.

Programs to develop reduced cost cigarette papers based on wood pulp are being conducted with KC and Ecusta. European suppliers such as Papeteries de Mauduit and Wattens have submitted wood pulp papers as well.

Adhesives - There are four major suppliers of cigarette construction and packaging adhesives-- National, Fuller, Findley and Ajax. Collaboration with adhesive suppliers was begun in 1989, and PM has signed a confidentiality agreement with National Starch and intends to initiate work on setting detailed adhesive specifications. In conjunction with National, a sideseam adhesive has been developed which contains a flavor-release compound for Project Ambrosia. Collaborative programs are likely to continue with adhesive suppliers as heavy basis weight papers are developed and we strive for commercial maker speeds with these papers. We anticipate adhesive problems for sideseam and tipping with the heavy basis weight papers. Adhesive development will be required to address these issues.

Vision Systems - The machine vision industry has undergone a shakeout during the 80's. The number of machine vision companies has been reduced from a peak of approximately 200 to a half dozen or so major players. There is still no standard in hardware, and each of these companies offers an advantage over the others in a particular application. PM Engineering has worked closely with Itran for pack inspection, Pattern Processing Technologies for cigarette inspection and Allen-Bradley for the inspection of tipping paper.

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R&D has recently developed a proprietary inspection procedure which allows global inspection of packs while minimizing the specialized skill required for setup and use. An effort is currently underway to negotiate an agreement with Itran to manufacture the system. The preferred hardware is the Fs-11 hardware under development by Itran.

Each of the inspection problems under consideration within PM has unique requirements that cannot presently be addressed by hardware supplied by a single manufacturer. It is anticipated that additional relationships will need to be formed.

Near Infrared Monitors - Near infrared (NIR) process monitors are in use in the tobacco industry for moisture measurements. However, the devices in use are for the most part "dumb" sensors, that is, they are set to measure radiation reflected from the samples at one or at most a few wavelengths. Currently, instruments with scanning systems with fiber optic options collect the entire practical NIR spectrum. Only development of application methods and software will permit adaptation of off-the-shelf hardware to process analysis for a variety of processing materials, additives, casings, etc., and possibly to blend discrimination. Innovative application of new concepts such as fuzzy logic software will reduce calibration requirements and enhance process control application.

Tobacco Seed - Northrup King (NK) has withdrawn from tobacco seed research and development, in part, because U.S. law prohibits commercial export of U.S. tobacco seed (i.e., limiting sales). Short-term, R&D and Leaf feel this does not pose a serious problem since NK will continue to sell their current stock and meet industry requirements. Long-term, if the U.S. law is not changed, tobacco seed R&D will fall on land grant universities. Some of these universities are under pressure to change their roles in this area due to anti-smoking campaigns and a lack of skilled researchers with an interest in tobacco. Future varietal development may require the establishment of a separate organization(s) to assist the universities.

Social and Political Influences

Social and political factors continue to be the greatest challenge to the industry. The major concern in this area is the anti-smoking movement and its impact on state and federal legislative activity. The results are evident in proposed legislation in the areas of smoking restrictions, advertising restrictions and sampling restrictions. Legislation relating to "fire-safe" cigarettes passed this year at the federal level and action is anticipated on the ingredient issue.

Another attack on the industry is the increasing state cigarette taxes and proposed increase in the Federal Excise Tax. As state governments and the federal government

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look for ways to increase revenue, cigarette taxes are one of the first to be proposed. These tax increases have an impact on the cigarette industry, and these factors are discussed later in the Future Factors Section.

The current emphasis of the anti-smoking movement, in addition to legislative activity, appears to be focused on environmental tobacco smoke and the non-smoker as well as the social costs of smoking. This activity is developing a changing social environment for the consumer, which the industry is responding to in the form of new products. These trends are anticipated to continue, and the next five years will be among the most challenging the industry has faced on the social and political fronts.

Perceived health concerns remain a major component of the anti-smoking movement. However, product liability, while still a threat, has not proven a profitable endeavor for the plaintiffs in these cases. Close monitoring of the scientific and legal status related to these concerns is essential.

External Analysis Summary

External threats and opportunities that arose from our external analysis summary are summarized below. Additional discussion on the future scenarios involving most of these current threats and opportunities is included in the section on Future Factors.

Opportunities

A number of market opportunities can be identified from the External Analysis Section. These include: a product "perceived" as being "safer" by the consumer, international market growth, menthol products, increase in market segments, proprietary processes and products, environmental smoke abatement-design and specifications, reduced ignition propensity product, and a non-conventional cigarette.

Threats

Threats developed from the External Analysis Section include: pressure to increase taxation, government regulation of cigarette construction (ignition propensity), government regulation of ingredients, social unacceptability, foreign competition, product liability, novel product development, margin erosion due to strength of price/value category, smoking and health issues, limitation or ban on advertising, potential product tampering, and government attack on nicotine.

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**Analysis of Future
Factors**

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F. ANALYSIS OF FUTURE FACTORS

MARKETPLACE FACTORS

COMPETITIVE PRESSURES - DOMESTIC

Status:

Sales - The data presented for 1989 is distorted due to the fact that RJR realigned year end inventory. This fact is evident in both their 1989 volume and Market Share data.

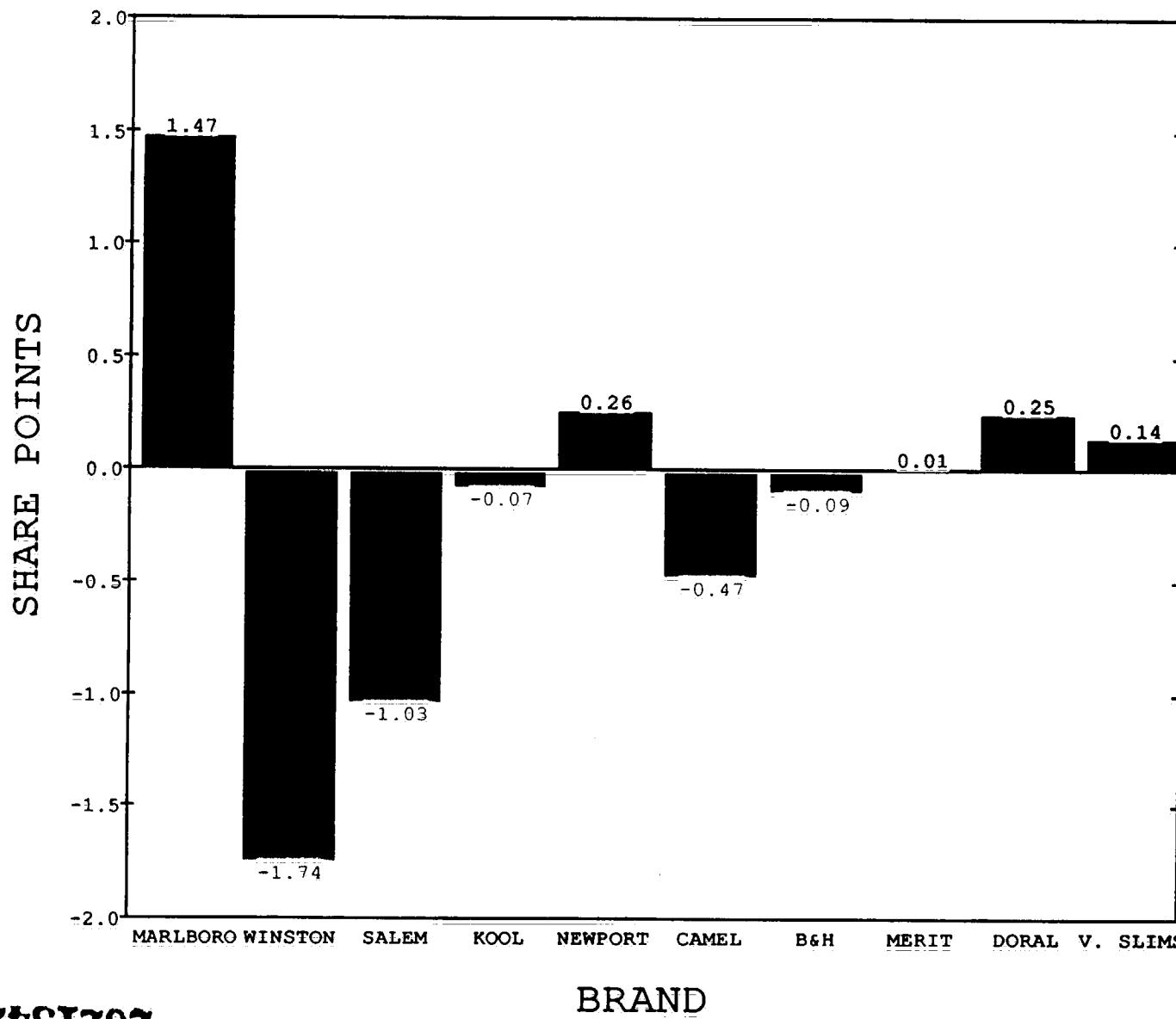
<u>RJR Volume *</u>		<u>% Change</u>
<u>1988</u>	<u>1989</u>	
177.21	149.43	- 15.7
<u>RJR Market Share</u>		<u>% Change</u>
<u>1988</u>	<u>1989</u>	
31.8%	28.5%	- 3.3

* Billion Units

In addition to this trend noted for RJR, total industry volume showed a decline of 6.1% to 523.88 billion units from 558.12 billion units in 1988 (sales data obtained represents Maxwell Report Year End Estimates). It is anticipated that industry volume should be relatively flat for 1990. PM USA's accomplishments during 1989 are even more dramatic when one considers RJR's artificially depressed 1989 figures. PM achieved volume growth in 1989 to 219.5 billion units from 219.3 billion units in 1988. This volume growth was accompanied by a Market Share growth of 2.6% for a total of 41.9% of the U.S. cigarette market. The only other company to demonstrate both volume and share growth was Liggett from 15.7 billion units in 1988 to 17.0 billion units in 1989 and a share growth of 0.4% to 3.3%. This is the first growth for Liggett since 1984. While experiencing a volume decline, Brown & Williamson increased share by 0.5% to 11.4% of the market. American Brands maintained a 7.0% share of the market for 1989. The top ten brands (Figure 6) held similar standings to last year. Of the brands showing share growth, Marlboro advanced 1.5 share points, Newport, Doral and Virginia Slims improved in share, and Merit remained the same. Winston, Salem, and Camel suffered significant losses in share, some of which is due to RJR's no load decision.

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Figure 6
TOP TEN BRANDS
SHARE CHANGE: 1989 VS 1988



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New Products - A total of 68 new packings were introduced into the market place in 1989. All of the new product introductions/test markets from January 1989 through May 1990 are listed in Table 14. Of these, 39 packings were introduced into the price value category. Most noteworthy was Liggett's introduction of Pyramid, which opened the sub-generic category. This category was soon expanded with American's Montclair and PM's introduction of Bristol. RJR was active with the introduction of Vantage Excel 100's. This product featured a cigarette paper containing magnesium hydroxide, which reduces visible sidestream smoke. The advertising claimed "less smoke from the lit end." The product was withdrawn from test market. RJR later introduced into test market Chelsea 100's Box (plain and menthol). This product utilizes ethylvanillyl-glucoside in the cigarette paper. The advertising claimed "this cigarettes has smoke that smells good." This test market was maintained, and the full circumference product Horizon was later introduced with the same odor feature. Lorillard introduced Spring Lemon Lights 85's and 100's (Regular & Menthol). The flavor source in these cigarettes is citral. PM introduced Virginia Slims Superslims 100's Box nationally. This product has a 17mm circumference and features low visible sidestream smoke. PM also launched into test market Next De-Nic and Merit De-Nic. These test markets are PM's first introductions of products developed in the ART program.

The new product activity is an indication of the growth of the price value segment, with 57% of new product activity in this segment. In total 14.9% of the U.S. cigarette market is represented in this price value category. This is a share growth of 3.4%. RJR remains the leader with a share of 31.8% of this category. RJR's Doral leads with a 1989 volume of 19.03 billion. Brown and Williamson's share was 23.3% with a growth of 2.9%, and, PM had 23.2% share with a growth of 2.2%. The source of growth is in the branded generics subcategory. The brands Doral, Cambridge and Richland grew, and new entries Viceroy, Alpine and Magna expanded the branded generics.

Social Acceptability - Domestic competition is not limited to the other tobacco companies. Smokers quitting smoking through a variety of cessation programs is a big factor in the market decline. Non-tobacco companies could enter the market place with a Premier type of product or another device to substitute for smoking. Our new product programs need to be structured to develop products which satisfy consumer needs. The social environment of our consumers is changing and new products need to be developed to fit into these social trends.

Likely Scenario:

Sales - Industry sales are likely to decline at a rate of about 3% per year. Due to RJR's nolbad action in 1989 and the resulting distortion in 1989 sales, 1990 sales volume figures are likely to be affected in a reverse manner, since RJR product normally sold in

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Table 14
New Product Introductions/Test Markets

January, 1989

PM	Alpine 80; Alpine Lights 80 (Box)
RJR	More White Lights 120 (Plain & Menthol)
RJR	Vantage Excel 100
RJR	Best Value Full Flavor Filter Lights Filter Lights Menthol Ultra Lights 100
B&W	Kool Ultra Lights
B&W	Kool Lights
Liggett	Pyramid
Liggett	Pyramid Ultra Lights
Liggett	Pyramid Lights Menthol

March, 1989

RJR	Chelsea 100 (Plain & Menthol)
RJR	Doral FF Menthol
B&W	Belair Lights (85 and 100)

July, 1989

PM	Next Ultra Low Tar & Low Tar 85 & 100
PM	Next Ultra Low Tar & Low Tar Menthol 85 & 100
PM	Merit De-Nic® Ultra Low Tar & Low Tar 85 (Plain & Menthol)

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Table 14 (continued)

New Product Introductions/Test Markets

May, 1989

PM	Marlboro Ultra Lights 85 & 100 (Box)
RJR	Doral Ultra Lights 85
RJR	Magna Lites 80
American	American Filters (85 & 100)
Lorillard	Spring Lemon Lights 85 & 100 (Plain & Menthol)

September, 1989

PM	Virginia Slims SuperSlims 100 Box (Plain & Menthol)
PM	Cartier 100 10's & 20's (Plain & Menthol)
Liggett	Pyramid FF (85 & 100)
Liggett	Pyramid FF Menthol (85 & 100)
American	Misty Lights 100 Box (Plain & Menthol)
American	Malibu Lights 100

November, 1989

American	Montclair Lights 100 (Plain & Menthol)
American	American Lights 100 Menthol
Lorillard	Harley Davidson 85
Lorillard	Harley Davidson Lights 85

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Table 14 (continued)

New Product Introductions/Test Markets

January, 1990

PM	Bristol Lights 85 (Plain & Menthol)
PM	Bristol Lights 100 (Plain & Menthol)
PM	Bucks FF 85, Bucks Lights 85
RJR	Uptown 80 & 85 Menthol

March, 1990

RJR	Dakota 80, Dakota Lights 80
RJR	Salem Gold 85
Lorillard	Heritage Lights 85 & 100

May, 1990

PM	Bristol FF 85 & 100
PM	Bristol Ultra Lights 100 & 85 (NF)
PM	Next De-Nic® 85 & 100 (Plain & Menthol)
RJR	Horizon 100 (Plain & Menthol)
RJR	Salem 80 (Box)
American	Pall Mall 100

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1989 was pushed into 1990. This may result in 1990 industry sales being higher than predicted, and PM market share being lower than predicted.

New Products - Brand proliferation is expected to continue since, in the tobacco industry, even products with a relatively small market share can be profitable.

Social Acceptability - RJR has test marketed three products in the past eighteen months that address the social concerns of consumers. Vantage Excel 100 lowered the visibility of sidestream smoke, and Chelsea and Horizon altered the aroma of sidestream smoke. PM launched Virginia Slims Superslims which provided reduced sidestream smoke visibility. New products which address concerns of consumers provide an opportunity to gain additional market share. Several R&D programs are committed to implementing technologies into new products. Technologies which offer advantages to the consumer should be developed into acceptable cigarette products to give us an advantage in the market place.

R&D Programs:

- Menthol
- Project Ambrosia
- Low Tar/High Flavor (Project BOLD)
- Filtration Research
- Paper Technology/Reduced Sidestream
- Domestic Product Support
- Project Beta
- Project ART

COMPETITIVE PRESSURES - FOREIGN

Status:

Philip Morris 1989 US export sales increased 13.4% over 1988 sales. Production forecasts for 1990 predict an increase of approximately 32% over 1989. As the domestic market continues to decline, these export market opportunities must be pursued aggressively to maintain production volumes.

Foreign cigarette manufacturers continue to provide Philip Morris with competitive challenges. JTI continues to dominate the Japanese market with an 85.1% share. JTI is countering foreign competition aggressively by introducing upscale new brands, sponsoring campaigns for young urbanites and increasing vending machine exposure. They introduced nine new brands to the marketplace in 1989. This heavy emphasis on

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new brand introduction (Table 15) is continuing in 1990, along with extensive promotion of Mild Seven, the dominant brand family in Japan. Tekel dominates in Turkey with a market share of 85.1%. In Taiwan, the Taiwan Tobacco and Wine Monopoly holds an 85.6% market share. The top seven brands in Korea are produced by Korean Tobacco & Ginseng which has a market share of 96.2%. PM brand family market performance is shown in Table 16.

Likely Scenario:

Philip Morris US export production is predicted to continue increasing during the next five years, with a compounded annual growth rate of 5.3% overall. The most growth is expected in the Asian markets. Yugoslavia and the USSR are also expected to be major export markets during the next five years. Other US tobacco companies will exert competitive pressure on Philip Morris as they strive to increase market share in other countries in order to maintain the viability of their US operations. Proactive product development and aggressive pursuit of market opportunities will be required to achieve international market share growth. Additional Asian countries, such as Thailand, will provide new market opportunities.

Import segments will continue to grow in the Asian markets. Production forecasts indicate that PM exports to the Asian markets and Saudi Arabia are expected to increase through 1995 (Table 17). Exports to Yugoslavia and the USSR are expected to increase sharply through 1991 and then stabilize. Exports to Kuwait are expected to resume in 1991. Current events in Kuwait are unpredictable as is their potential impact overall on these forecasts. Exports to Turkey are expected to increase through 1992 and then begin declining. As the import segments grow, local manufacturers will provide increased competitive pressure as they try to maintain the high market shares which they currently hold. Aggressive, innovative product development and promotion can be expected.

PM export performance in specific international markets is provided in Tables 18 and 19. PM's share of these markets is increasing with the exception of Saudi Arabia. PM has a significant portion of the markets in Saudi Arabia, Hong Kong. However, due to increasing import competition in many of these countries, PM's share of the import market is generally decreasing with the exception of Taiwan.

Table 20 offers an analysis of current worldwide, international and domestic market trends for both PM and the industry. Both the volume and rate of growth of the international market offer some clear opportunities. In addition, the quality and availability of domestic leaf can sometimes provide a clear product advantage to a US company in the international market.

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